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Manager and Secretary: E. S. MIDDLETON.

OFFICE: 4, LUDGATE HILL, LONDON, E.C.4.

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Electrical Research.

IN anticipation of the annual meeting of the British Electrical and Allied Industries Research Association, which is to be held on February 8th, the annual report has been issued for the period ending September 30th last. As usual, it contains a survey of the investigations which have been in progress during the year, covering a very wide field and dealing with matters which are certainly, as claimed by Mr. R. W. Paul, chairman of the Council, "of prime importance to the electrical industry." At a Conference of all sections of the industry which was held in June, under the chairmanship of Sir Richard Glazebrook, it was unanimously agreed that the Association had achieved results of great benefit not only to industry in general but also to the nation, which could have been secured in no other way, and that efforts should be made to extend the scale of its operations, by increasing the expenditure from £25,000 a year to double that amount within five years.

Provided, of course, that the money is spent as wisely as it has been in the past, we hold that the greater the expenditure the better, for the return obtained vastly exceeds the original investment. It is regrettable that the burden still falls mainly upon the shoulders of the manufacturing section of the industry, seeing that the electricity supply section is directly benefited by the work of the Association, and in his turn the consumer gains by the reduction in cost of electrical energy. A Committee was appointed to carry out the policy initiated by the Conference, and we hope it will be able to present a satisfactory report to a second Conference which will probably be summoned at an early date.

It may not be generally realised that, in addition to the efficient staff over which Mr. E. B. Wedmore presides, and the large Council of eminent men representing the six leading electrical associations, the organisation comprises 16 sections, each under the control of a comprehensive committee, and some 50 sub-committees and panels dealing with specific subjects; 80 per cent. of the huge personnel engaged in this work is provided by the manufacturing section of the industry, and we feel that the electrical fraternity is under a great debt to this large body of voluntary workers who sacrifice their leisure for the common good. The most practical way in which it can express its appreciation of their labours is to provide them with ample funds to carry

out researches on an ever-increasing scale. The assistance hitherto derived from the Department of Scientific and Industrial Research, at a diminishing rate, comes to an end next year, and though the Department has in contemplation a scheme for the further assistance of research in general, it is imperatively necessary for the electrical industry to place its Research Association on a sound basis of assured financial resources. The best researchers cannot be attracted into this professsion unless their future is guaranteed.

Turning from the Association itself to the industry which it serves, we note with regret the statement that in some cases it appears that the information contained in its reports fails to reach the hands of the persons who could most profitably make use of it. This is a matter which should have the attention of the managers of the manufacturing concerns and electricity supply undertakings to which the reports are addressed; to have the information available and not to make full use of it is deplorable.

Climate and Overhead Lines.

In the admirable paper presented to the Overhead Lines Association last week by Mr. C. W. Molle, a number of important facts were brought out with regard to the climatic conditions under which overhead lines operate in this country; the author had obviously expended a great deal of time and labour in examining the records of the Meteorological Office, and information derived from other sources, and in reducing the results of his observations to a compact and intelligible form. His paper is abstracted elsewhere in this issue, but the members of the Association will receive a more extended report of it, and will thus enjoy the full benefit of his researches.

Amongst the many interesting points that emerged were the facts that wind-pressure near the ground is less than at greater height, consequently lower safety factors should be used for shorter poles; that while gust-pressure may be double that of the steady wind, the effect of a gust is purely local; and that wires of 0.03 sq. in. or greater cross-section do not break under wind-pressure alone. But, as the president, Mr. W. Fennell, pointed out, the most important conclusion was that the wind pressure under ice-loading conditions had been over-estimated—to such an extent that, in Mr. Fennell's opinion, the wind pressure experienced in the absence of ice-loading not improbably exceeds the wind-pressure exerted on wires loaded with ice. By far the most likely condition in snowy weather, says the author, is a wind of 12 miles per hour or less; and the lowest temperatures always occur with winds of 12 m.p.h. or less.

As we have remarked on previous occasions, the overhead-line regulations have been drawn up on the assumption that a high wind, a low temperature, and a coating of ice on the wires will occur simultaneously, whereas in point of fact all these adverse conditions do not coincide. Mr. Molle suggests that it would be perfectly safe, in the case of wires of not less than 0.03 sq. in. cross-sectional area, to allow only for the maximum wind-pressure of the particular district where the wires are to be erected, without any other load, at a temperature of 30 deg. F.

Clearly there is a great deal to be learnt yet with regard to overhead lines and the conditions that they have to meet, and such papers as this are valuable contributions to our knowledge of the subject.

Electrical Export Trade.

No doubt many thoughts on export trade have been provoked by our article of last week on the urgency of overseas development, and others will originate from consideration of the import and export electrical trade statistics which are tabulated and commented upon in this issue. Though weather conditions such as we have been passing through lately may colour the view of those who are temperamentally susceptible, they have no effect upon actual facts and upon figures, whether of volume or value or rising or falling prices. But whatever deductions we may be inclined to make in our calmest moments, from past trade events, we cannot go far wrong at the moment if we once again stress the necessity for electrical and allied firms to put forth their utmost endeavours in the overseas markets. There is not only business to be obtained in the ordinary course of Colonial and foreign travel, or through agents, that is, the sort of business that concerns all of our firms and companies, but there is big work which cannot easily be handled by the average company single-handed. While some of our readers, including men of considerable standing and importance, have been looking askance at recent amalgamation movements, neither they nor anybody else is blind to the fact that large combined concerns must possess considerable power abroad and cannot fail to be advantaged in the negotiation of big business, even business with attendant risks such as may characterise transactions with Russia and certain other countries. It may be that by reason of those very international connections which occasion concern to some who are naturally anxious for the continuance of British interests unimpaired, these amalgamated interests may find it possible to so operate that from time to time big slices of business will be secured to help to keep our factories in full, and therefore in economic, operation. Yet there appears to be plenty of scope for scores of other electrical manufacturing concerns to trade profitably in face of foreign competition, and on a larger scale than hitherto in Colonial and foreign markets, if they will come together in groups. The largest undertaking of the kind that received much notice was the big co-operative engineering company which was at work in Russia and Siberia when the war occurred. Circumstances over which the company had no control were its great source of trouble, but our recollections of the plan are very vivid regarding the great scope that there seemed to be. Other such combined efforts have taken place in Egypt, China, and other parts of the world, and are continuing to-day. Failing any other thorough-going form of export trade co-operation here, it would seem that there ought to be an opportunity for a big British Empire electrical development and trading company in which various interests could unite on a business basis, making such an investment jointly as would be comparatively easy for each without running too large financial risks. We might then witness something effective and impressive in the way of united travel, visiting and reporting electrically upon the great overseas markets.

The Faraday Centenary.

On August 28th, 1831, Faraday discovered the phenomenon of electro-magnetic induction, upon which rests practically the whole art of electrical engineering; for even those branches of it which could to-day be practised in a small way without the use of induction, such as electric lighting and electroplating with primary batteries, have attained their present advanced stage of development with the aid of the dynamo. That epoch-making discovery was but an episode amongst Faraday's monumental achievements in many other branches of physics and chemistry—but to our industry it was his crowning triumph, and he himself, with prophetic insight, attached great importance to it. His work was done at the Royal Institution, and the Managers of that fortunate organisation have rightly taken the lead in calling together a conference, embracing the leading electrical associations and the British Association—whose centenary also falls in 1931—to discuss proposals for the adequate celebration of the Faraday Centenary. It is thought that many other bodies concerned with pure or applied science will be interested in the proceedings and will wish to take part in the arrangements, and it is suggested that the opportunity would be most appropriate for "a review of the great contributions which British workers have made to the scientific and industrial advances of the past century"—a record which will certainly astonish those who are apt to decry their country. Needless to say, we shall cordially support the movement to celebrate the Faraday centenary in due form.

A Large Hydro-Electric Scheme.

The Grimsel, Switzerland, project is claimed to incorporate one of the largest and most elevated structures in the world.

By G. A. de MESTRAL.

THE consumption of electrical energy for households and industrial purposes is increasing rapidly in Switzerland from year to year, and from the point of view of national economy it is clear that falling water is the source on which the country must rely for its supply of power. Neither coal nor oil is to be found in the soil, and every ton of coal has to be purchased abroad; hence the Government railways and industries have turned their attention increasingly to the production of hydro-electric energy on a large scale.

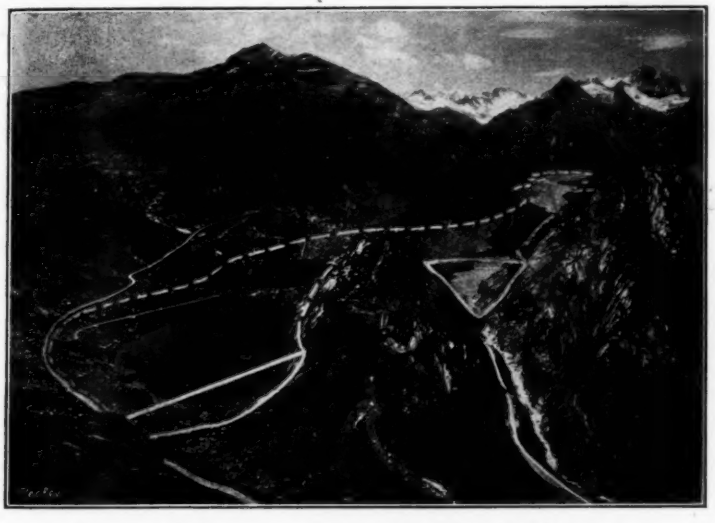


Fig. 1.—Grimsel Pass, with Indications of Projected Dams and Storage Lake.

Fortunately Switzerland has an abundant supply of water power, "white coal"; the Rhine, Rhone, Aar, and Reuss are all deep and rapid streams, but they are subjected to one great drawback as regards the economical production of electric power. Throughout the five or six months of the winter season, when the consumption of power is greatest, the flow of water is at its minimum, and it is impossible to meet the demand, while in the summer, when the demand is lessened, the flow of water is increased by the melting of the snow on the higher Alps. The only remedy is to construct large reservoirs or artificial lakes high up in the mountains to retain the summer supply of water for use at the power stations during the winter.

A typical example of such a storage scheme is in connection with the enormous power stations now being erected in the upper valley of the Aar river. This plant is being built by the Kraftwerke Oberhasli, a daughter company of the Bernische Kraftwerke. The Grimsel pass, from which this power plant gets its name, rises to an altitude of 7,130 feet above sea level and allows communication between the valley of Hasli and the Rhone valley. About 1,000 feet below the top of the pass, hard by two tiny lakes, is situated the famous Grimsel hospice, a solid building which for over a century has afforded a refuge to many tourists. At this point Nature favoured the construction of an artificial lake by providing a rocky hill in the midst of the narrow valley. From the accompanying illustration, fig. 1, showing the wild scenery in its natural state, it is evident that a large drainage area may be closed up by erecting two dams, as shown by the full lines. Twelve million cu. ft. of concrete will be required to build the higher dam to the right. It is to be curved at a radius of 294 ft., and will be 360 ft. high, 815 ft. long at the crest, and 210 ft. thick at the base. The dotted line indicates the level of the pool which is to be created by the dams. It will extend up stream for a distance of about three miles to the mouth of the Unteraar glacier. With a drawdown of 270 ft., the lake will have a storage capacity of 3,500 million cubic feet available for plant operation.

Fig. 2 illustrates the great change which has taken place on Grimsel since 1926. The hill, formerly barren, is now covered with men's barracks, with buildings sheltering stone-breakers and concrete mixers, and with steel structures for cable cranes and conveyors. A new hospice has already been erected 260 ft. above the old one, as the latter will be engulfed in the waters of the lake. It was hard work to lay out an aerial cable-way a distance of 11 miles through a valley subjected to

Fig. 2.—Developments at Grimsel since 1926.

heavy storms and avalanches; but only by this means of conveyance is it possible to transport in a short time the enormous quantities of cement needed at Grimsel.

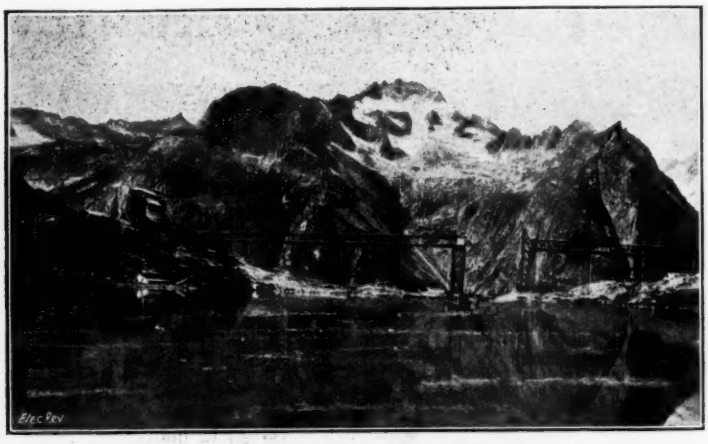


Fig. 3.—Lake Gelmer, showing Steel Bridge.

Fig. 4 gives an idea of this cable-way as it runs over big spans above precipitous glens.

Near the dam on the lake side is located the intake of a pressure tunnel, which has been driven through the rock for a distance of 3.2 miles in order to conduct the water to another small lake, the Gelmersee. Not far from the inlet at Grimsel the tunnel enlarges to a chamber equipped with safety gates and three motor-operated butterfly valves. This room may conveniently be entered from the guard's dwelling house on top of the mountain by means of a lift, running down through a vertical tunnel to a depth of 427 ft. Figs. 3 and 5 depict Lake Gelmer, the level of which is also to be raised by another dam, in order to increase its capacity. When finished, the water impounded will have a volume of 460 million cu. ft. A steel bridge has already been erected, from which the concrete will be poured. The cable railway for the transport of the material to Lake Gelmer is shown in fig. 6. Half-way up the slope may be seen a wood structure supporting the cables of the aerial cable-way crossing this line.

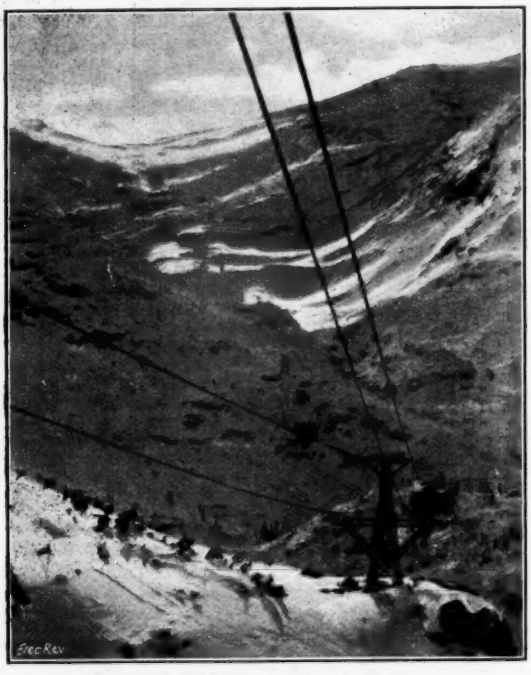


Fig. 4.—Part of Aerial Cable-way.

The water from these two high reservoirs will be conducted through a pipe-line tunnel to the power house Handeck. The pipes of 7 ft. 6 in. clear width on the upper part of the penstock, and the banded pipes of 6 ft. 10 in. internal diameter on the lower part of it, are all welded together electrically, and eventually the line will be entirely embedded in concrete.

The power station is equipped with four generating sets, each rated at 30,000 h.p. when operating at 500 r.p.m. under an effective head of 1,770 ft. The hydraulic turbines, built by the Escher Wyss Manufacturing Co., are of the vertical-shaft impulse type, provided with two nozzles. Much care has been taken to protect the machinery against possible damage by the burst of a high-pressure pipe or a gate. Although an automatically-governed butterfly valve allows the penstock inlet to be shut practically at once, the water issuing at a velocity of about 330 ft. per second would be able to occasion serious damage before the outflow was stopped. Therefore, the turbines, with their inlet and nozzle pipes, are arranged below the floor level, the latter being protected by a heavy covering of reinforced concrete; each turbine will be separated from the other and from the gates by a thick concrete wall.

The generators located in an entresol are directly connected with the turbines. These were built by the Maschinenfabrik Oerlikon, and are designed for loadings of 28,000 kVA. On top of each turbine are mounted an exciter and an auxiliary exciter, both extending over the main floor of the power house. The main generators will supply at 11,000 volts, and the pressure will be raised to 50,000 volts by means of step-up transformers for transmission to Innertkirchen, a distance of eight miles. On account of the prevalence of avalanches on both sides of the valley, it has been decided to conduct the current by cables, which are laid in a tunnel. A small railway running through this cable tunnel will allow authorised persons to reach the power house during the winter without being exposed to the severe climatic conditions.

At Innertkirchen, where the valley presents a more pleasurable aspect, are situated the offices of the Kraftwerke Oberhasli A.-G. A large outdoor station will be erected at this point to raise the pressure from 50,000 to 150,000 volts. The step-up transformers and the high-pressure switches are to be supplied by the Brown, Boveri Manufacturing Co. From there the outgoing lines will distribute the power to the

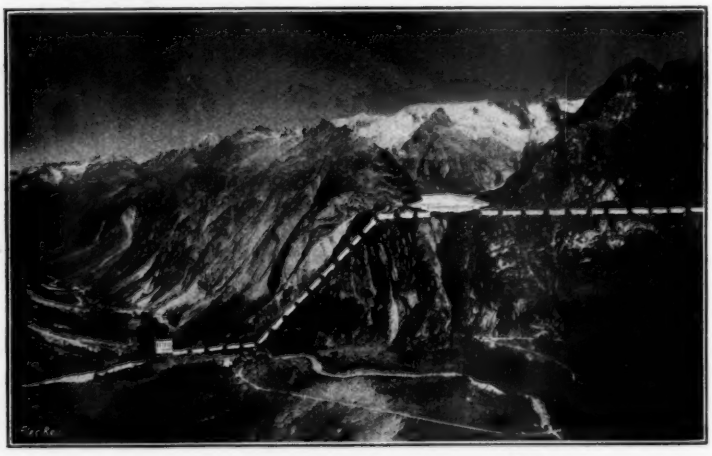


Fig. 5.—Lake Gelmer and Power House.

load centres of the Bernische Kraftwerke and the city of Basle. As it has been planned also to utilise the water power between Handeck and Innertkirchen, as the result of the growing demand, the installation of the power house, Handeck, means the first step in the construction of the most powerful hydro-electric plant in Europe. All the design and construction work is under the supervision of Mr. A. Kaech, director and chief engineer of the Kraftwerke Oberhasli A.-G.

Naturally the Grimsel has become an attractive spot for those people who take an interest in great engineering works. During the summer the place is within easy reach by motor car, driving between Meiringen and Grimsel-Hospice. It may be that visitors will regret that the solitude of this rocky defile is disturbed while the work of construction is going on, but, nevertheless, they will be struck by the giant structures which man has provided to harness Nature's power. For those who live in these high Alpine valleys, electricity means cheap power for home industry and consequently a better standard of life. Hitherto many have been driven to emigrate overseas, as the summer was too short for the development of flourishing agriculture. For town-folk electric power means cheaper living, greater cleanliness and healthier conditions.

A report recently drawn up by Dr. Carl Mutzner, director of the Swiss Department of Water Economy, shows that there are now over 6,000 hydro-electric plants in operation in Switzerland, with a total capacity of 2,565,405 h.p., or 0.648 h.p. per head of the population.

Fig. 6.—Cable Railway to Lake Gelmer.

Gramophone Reproduction.

An indication of what the electrical reproduction of gramophone records can be like under proper conditions, how the latter can be obtained, and whether the result is really worth while.

By ERNEST W. BRAENDLE, A.M.I.E.E.

THE advent of the thermionic-valve amplifier and loud-speaking telephone method of reproducing broadcast speech and music aroused interest in the possibilities and advantages of the much-advertised electrical "pick-up" for gramophone record reproduction by means of such devices instead of a normal sound box.

The several reasons for employing the electrical method include the fact that dance music can be amplified, several loud-speakers may be used to generalise the sound, needle scratch can be largely eliminated, &c.; but it is feared that in a great many cases its use is mainly dictated by a desire for novelty, which statement is not intended to imply that electrical "pick-up" is not worth while, but certainly that the quality of the "pick-up" is more often than not ruined during the subsequent processes of amplification and reproduction.

A normally safe criterion is that if the same amplifier be employed for broadcast radio-telephone reception as for gramophone record reproduction, then only that volume and that quality which are obtained in the former case will be available in the latter, however good the "pick-up" may be. A recent direct check between the best commercial mechanical gramophonic reproduction available and the best commercial electrical reproduction, of equal intensities of output, barely permitted of adequate comparison. Mechanical reproduction still suffers from that sense of restraint which, whilst being most elusive of expression, is so serious in its effect. Pianoforte especially, as well as violin and other solos, are very good, but they are not the same as the extremely realistic reproduction from the same record obtainable electrically. It is suggested that the defect may be due to the fact that, apart from the more true reproduction of both the upper and lower registers by the electrical method, the mechanical sound-box, requiring greater energy for its operation, fails to register many of the finer fluctuations of the record track, with the result that the true musical decrement is not maintained, so that overtones and beat notes, due to the overlapping of sustained frequencies, are not reproduced.

Briefly, the old mechanical method of recording consisted of collecting the varying air-pressures of the sounds required and concentrating by means of a long horn their energy for cutting vertical, or lateral, grooves in a rotating wax surface. By electrolytic processes, metal was deposited on the wax surface, from which a die was eventually made to produce replicas in suitably hardened wax. In order to produce sufficient mechanical energy for the initial cutting, it was essential that either the artists or the source of sound be sufficiently close to the recording apparatus, and this involved the serious disadvantage of crowding orchestras and bands into uncomfortably small areas.* In the case of certain instruments, such as the violin (other

* "Methods of High-quality Recording and Reproducing Music and Speech," by Maxfield and Harrison, *Journal*, A.I.E.E., March, 1926.

than solo), it was necessary on occasion for the artist to utilise a special instrument fitted with a sound-box and horn in order to create sufficient intensity of sound, which meant that more often than not the artist played on an unfamiliar instrument, which did not tend to improve the spontaneity of the performance. Besides such obvious defects, mechanical recording suffered from extremely peaky response characteristics, which created the familiar " thin " gramophony tone, together with a total lack of bass notes.

With the new electrical recording methods, since the initial energy available can be amplified to any desired level, not only is it possible for artists to perform in a more natural atmosphere, often in the actual building with which they are familiar, but also more than one point of " pick-up " (some form of microphone) may be employed and, if necessary, corrective devices inserted to bring about a proper balance between bass and treble. Helmholtz demonstrated that the audible quality of any tone depends entirely on the amplitude of the harmonics, not on relative phasing; therefore, it is essential for the true reproduction of any note that not only the initial frequency be unimpaired, but that the relative amplitude of the harmonics and overtones

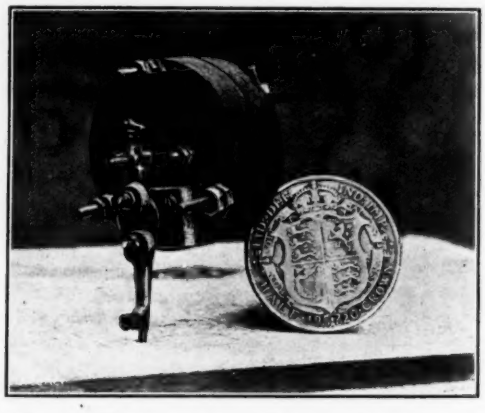


Fig. 1.—Electrostatic " Pick-up," Differential Characteristic.

of that note be unimpaired also. It is interesting to note in this respect that with the advent of electrical reproduction it has been found possible to insert an artificial echo where desired, by superimposing the " pick-up " of two microphones, disposed in such relation to the source of sound that a lag is introduced between the two, causing the necessary phase displacement.

The operating time of the records is dependent on two factors: the speed of rotation and the pitch of the guiding track. Assuming that both factors are fixed, then if the record is made with a lateral cutting stylus, the permissible amplitude of cut, so as not to cause damage to the neighbouring track, must be definitely limited. Now, the amplitude of the wave-form for a constant sound energy is inversely proportional to the frequency; therefore, if equal balance of treble and bass are to be maintained, the amplitude of the stylus cut must be much greater in the latter case than in the former. In practice it is not possible to attain to the ideal, and a compromise is effected by recording with a " constant energy " characteristic down to about 150 cycles per second, and thence with a " constant amplitude " characteristic; in other words, from 150 cycles upwards to about 5,000 the amplitude of cut for a given energy is made inversely proportional to the frequency, and below 150 cycles it is made constant, giving the resultant energy output a rising characteristic.

Modern gramophones are designed for a reasonably high efficiency over the musical scale, and manufacturers now make use of a definite electrical analogy when designing their mechanical and acoustic systems. Since an idea of the equivalents may be useful later they are given below:—

Force (dynes)	Pressure (volts)
Velocity (cm. per sec.)	Current (amperes)
Displacement (cm.)	Charge (coulombs)
Impedance (dynes per cm./sec.)	Impedance (ohms)
Resistance	Resistance (ohms)
Reactance	Reactance
Mass (grammes)	Inductance
Compliance	Capacity

In the mechanical reproduction of gramophone records, neglecting the record itself, many factors affect the accuracy of the sounds reproduced; such as correct governing of the turntable speed, the accoustic properties of both sound-box and horn, the position of the gramophone in the room, &c., and they apply equally well to electrical reproduction, only the sound-box and horn are superseded by the " pick-up " amplifier, and loud-speaker. Although this would appear to create complications, the fact that the amount of energy taken from the record by the " pick-up " need be very small indeed, compared with that taken by the sound-box (approximately 1/100th), permits the " pick-up " to be designed in such a manner as to allow almost perfect tracking of the stylus needle, a most important factor when accurate separation of sounds is required, not to mention its beneficial effect on the life of the record.†

The " pick-up " is that part of the apparatus which is employed to convert the mechanical impulses imparted to the needle by the record into electrical impulses of as nearly as possible identical form, the two most important methods of doing which are the electromagnetic, wherein the fluctuations of a reed of ferrous metal in the air-gap of a permanent magnet are made to induce electric currents in suitably disposed coils, and the electrostatic, wherein the needle is made to cause fluctuations in the capacity of a small condenser. It is generally appreciated that the electrostatic method has theoretically many advantages over the electromagnetic, but hitherto it has not been commercially practicable, owing to the necessity for quite large moving areas in order to obtain even moderate sensitivity. However, a recent design not only permits of the use of considerably reduced moving areas of electrostatic devices, but permits them also to be made with a differential characteristic. The experimental model shown in fig. 1 operates on the differential principle, and is equal in sensitivity to the best commercial electromagnetic unit available when polarised with a total of only 60 volts. Since, however, the electromagnetic type is the most common, indeed the only one available to the public, only that type will be dealt with.

So many different types of magnetic " pick-up " are manufactured by firms of considerable repute that it is almost impossible to attempt a criticism of all, but it is essential to note that with only rare exceptions has attention been paid to other features than quality, or quantity of output, one of the exceptions being that made by a firm of well-known gramophone manufacturers. Whilst fully admitting the absolute importance of both factors, manufacturers should not lose sight of the excessive, in some cases fatal, wear which a badly designed " pick-up " causes to the record. Record wear may be divided roughly into two parts: that due to the pressure of the needle on the record, and that due to the lateral reaction of the needle in the track. Lateral reaction may be divided into three sections: that due to resilience (compliance), which causes the lateral velocity of the stylus to lead that of the track; that due to mass causing the stylus velocity to lag behind that of the track; and that due to the mechanical resistance offered to the motion of the stylus, which is in phase with the track and therefore, except when caused by excessive damping, is doing useful work and is unavoidable. In any case, quite independent of the conditions of resonance, which apply, of course, when the reactions of both compliance and mass are equal for

† " Progress in the Recording and Reproduction of Sound," by A. Whitaker, M.A. *Journal* of Scientific Instruments, Vol. 5, No. 2. February, 1928.

any given frequency, the damage to the track is considerable; although obviously, if serious resonance effects are not to take place, some degree of damping must be employed. Rubber is usually employed for this purpose, but it requires extremely careful design to introduce rubber so that its damping qualities may preponderate over its stiffness. Fluid damping is the ideal and has been employed in the case of at least one commercial "pick-up" with considerable success, re-

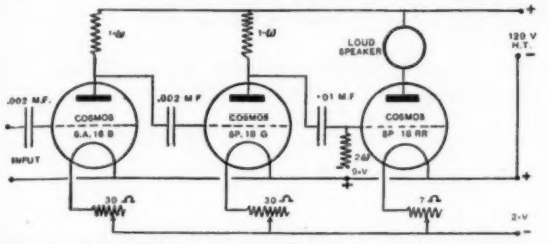


Fig. 2.—Amplifier, 3-valve R.C. Coupled, for Home Use with Batteries.

sulting in very little record wear, compared with that of an ordinary mechanical gramophone of the latest type.

The chief objection, then, to electrical "pick-up" is the possibility of excessive record wear, and prospective purchasers would be well advised to satisfy themselves that the stylus arm, whilst amply retaining reasonable freedom of movement, is adequately "dead," or non-resilient; also the presence of considerable masses of metal on any portion of the stylus is to be deprecated.

The amplification deserves attention: almost any type, whether transformer, or resistance coupled, by careful design of both circuit and components, can be made to provide a moderately level characteristic between 30 and 10,000 cycles. Since, however, it is claimed that for gramophone reproduction it is not desirable to exceed 5,000 cycles owing to the presence of excessive surface noise, or needle scratch, at or above this frequency, and since the "cutting off" at this frequency would not be noticed by the great majority of listeners, it is desirable from a commercial point of view, not only to ignore the higher frequencies, but even to insert a filter to eliminate them entirely.

Unfortunately, however good the design of the circuit may be, unless that of the components is equally good, the result may lack perfection and, although the quality of the components on the market has undoubtedly improved in the last few years, the only satisfactory condition is to design and build both circuit and components together. This is to be particularly emphasised in connection with transformer coupling, since, with only one or two exceptions, makers of commercial inter-valve transformers appear to pay little or no attention to serious electrical design, and even the exceptions are only really suitable if sufficient data were supplied wherewith to correctly design the rest of the circuit. Resistance coupling, although, perhaps, not giving quite such a high degree of amplification per stage, does permit of more simple design and construction, besides which reasonably good components with sufficient data are available. It has been the author's experience that, except for very special conditions, transformer coupling is not necessary, or desirable, for the general user; both the initial and upkeep costs are greater, not to mention the increased consumption of the valve anode circuit, causing a still greater drain on an already overtaxed battery, or, if an eliminator is used, increasing the load on the mains "smoothing" devices with a consequent increase in ripple.

Two designs of three-valve resistance-coupled amplifiers are shown: fig. 2 is for ordinary home use, employing battery-heated valve cathodes, and fig. 3 employes valve cathodes which are indirectly heated by an internal heating element fed with alternating current. The latter design, with 200-volt anode supply, is suitable for reasonably filling a large room, but at 300 volts will supply sufficient volume for small dances. For more pretentious apparatus, such as that suitable for large halls and theatre work, it is advisable to approach a reliable manufacturer of such apparatus with definite ideas as to exactly what is desired. Certain manufacturers are only too willing to co-operate in maintaining the efficiency of their apparatus, it being indeed in their own interests to do so, since, although the apparatus is most simple to operate, being a sensitive and delicate musical instrument, it does require periodical supervision and adjustment if its high standard of reproduction is to be maintained.

Loud-speakers of the moving-iron, or "reed" type, have not, so far, seriously competed with the moving-coil pattern, either as regards capacity for handling volume, or for the reproduction of the musical scale. Moving-coil loud-speakers of several types are now available commercially, the most interesting being the Rice-Kellogg free cone, the H.M.V. stretched-diaphragm, and the coil-driven diaphragm working into a horn (as developed by the Bell Telephone Laboratory's staff); each of them has its own advantages, although the horn type is, perhaps, necessary for handling extremely large volume.

A very important factor in relation to loud-speakers is the mode of coupling them to the last stage of the amplifier. In the case of a small output, a reed-driven speaker may be satisfactorily connected in the anode circuit of the last valve as shown in fig. 2. For coil-driven speakers and for larger power it is essential that some form of coupling between the anode circuit and the speaker windings be inserted in order to filter out the d.c. component of the anode circuit. There are three main methods of accomplishing this: the resistance-capacity, the choke-capacity and the transformer. From fig. 3 it will be seen that the trans-

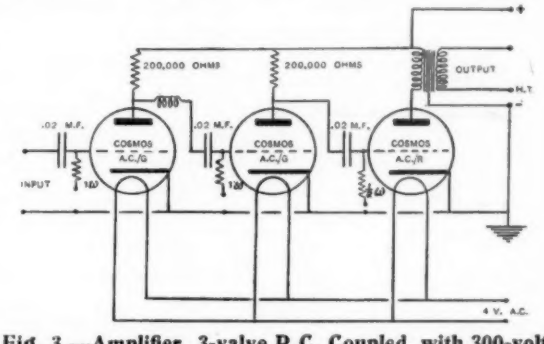


Fig. 3.—Amplifier, 3-valve R.C. Coupled, with 300-volt A.c.-fed Anodes.

former method is adopted as being the most satisfactory, although it is to be regretted that to the author's knowledge a really good output transformer is not yet available as a commercial component.

A somewhat wide view has been taken in our attempt to consider all the factors governing the good reproduction of gramophone records, and the reader may well ask "Is it all worth while?" The answer is that if he has a first-class and up-to-date mechanical gramophone, he will require extremely good and powerful amplifying gear to obtain the beneficial results that are available from electrical reproduction. If, on the other hand, he has reasonably good amplifying gear and a good, though old, gramophone, considerable improvement is available from electrical "pick-up." It should be emphasised, however, that it is not generally appreciated what a considerable volume of sound is produced by a good mechanical gramophone, even the smaller models, and if similar volume is required from electrical reproduction, it is essential that the whole of the amplifying and loud-speaking equipment be capable of handling that amount of power, quite independent of the type of "pick-up" employed.

In conclusion, the author would like to thank the Gramophone Co., Ltd., and others, for much useful information.

The Physical Behaviour of Lead Sheaths in Relation to Failures of High-Voltage Cables.

The author suggests that the alleged creation of voids in normal cables as a result of permanent distension of lead sheaths is a view which distinctly lacks foundation.

By C. J. BEAVER, M.I.E.E.

(*Continued from page* 98.)

There are one or two well-known facts regarding impregnating oils and compounds which bear yet further on the actual values of internal pressure producible in a cable. For example, in mineral oils the coefficient of expansion increases with decreasing density, while in resinous compounds it decreases with increasing resin content, so that the more viscous impregnating materials of either type are at an advantage from this point of view.

It is a very old principle that when a subject is hampered by theoretical assumptions which are likely to be

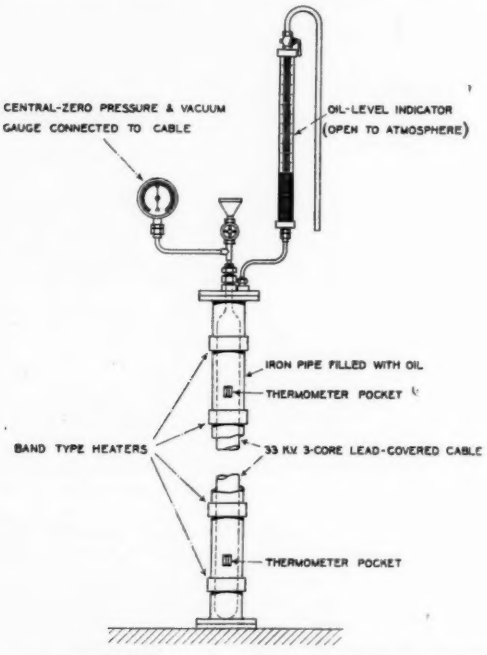

CENTRAL-ZERO PRESSURE & VACUUM GAUGE CONNECTED TO CABLE
OIL-LEVEL INDICATOR (OPEN TO ATMOSPHERE)
IRON PIPE FILLED WITH OIL
THERMOMETER POCKET
BAND TYPE HEATERS
33 KV 3-CORE LEAD-COVERED CABLE
THERMOMETER POCKET

Fig. 3.—Apparatus for Observing the Physical Behaviour of Cable under the Influence of Temperature Cycles.

erroneous, research upon it should be conducted in a manner which leaves the results to be decided entirely by experiment; and it will be apparent from the foregoing that in the case under consideration, exact and reliable information can only be obtained from practical quantitative experiments on commercially manufactured cable under conditions which closely simulate the working variations of temperature. In the course of a research in this field, a brief reference to which may be found in the I.E.E. *Journal*, Vol. 66, No. 380, p. 832, the writer devised a simple apparatus, illustrated diagrammatically in fig. 3, which can be used to demonstrate with an adequate degree of accuracy what happens in a given cable under such conditions. It consists of a length of iron pipe, capable of accommodating a two-yard length of 33-kV. three-core, paper-insulated lead-covered cable, which is sealed at its lower end. At its upper end the lead sheath is wiped on to a two-way fitting, one way being connected to a filling pipe, terminating in an airtight valve, and the other to a central-zero pressure and vacuum gauge. The containing pipe, fitted with band-type heaters and thermometers, is connected by a small copper pipe to a graduated glass tube, which is open to atmosphere at its upper end. After tightly bolting up the flanged joint at the top of the tube, transformer oil is poured in, so as to fill the annulus between the cable and the iron pipe, and all the remaining space up to the zero mark on the graduated glass tube, which functions as an oil-level indicator. A certain amount of the cable-impregnating medium is of necessity lost in making the end connections to the cable, and in order to make this good with absolute certainty, the pipe and its contents are put through a few daily cycles of heating and cooling. Any deficiency is easily observable on opening the valve when cool; the cable is filled with hot oil or compound, the valve is tightly closed, and further cycles of heating and cooling are performed on the cable. This is repeated until there is no doubt as to the cable being completely filled, when the valve is permanently closed, and the apparatus is ready to run on heating and cooling cycles of any desired duration.

With the apparatus and the contained sample length of cable thus prepared, let us consider for a moment the conditions which obtain during a cycle of heating and cooling. It is clear that the tube, the cable, and the oil will expand at different rates on heating, and as a net result a certain amount of the oil will be expelled from the containing pipe into the graduated glass tube, the quantity varying, of course, with the temperature. As the ratio of the coefficients of expansion of the transformer oil and the pipe containing it is of the order of 23 to 1, the rise of level will be appreciable. In the cases to which figs. 4 and 5 relate, it amounted to about 5.2 in. for a rise of temperature from 65 deg. F. to 140 deg. F. (18 deg. C. to 60 deg. C.). Included in the net volumetric expansion represented by this rise of level is an increment due to the thermal expansion of the cable and its internal pressure. Neither the actual values of the components (cable, oil and containing tube) nor their algebraic sum are, however, of moment from the point of view of determining the permanent distension, if any, of the cable sheath.

If on cooling to the datum temperature the oil level returns to its datum level, it is obvious that no permanent volumetric alteration to any component of the apparatus has been produced. On the other hand, if an increase in the oil level is found, it must correspond to an alteration in volume due to the cable alone, for it is beyond question that the iron tube will not have suffered distension, nor will the transformer oil have been decomposed at the low temperatures concerned, and these are the only contingencies which could affect their volumes. Conversely, it follows that if no permanent elevation of the oil level is produced, the cable must have behaved as an elastic body under the stresses resulting

from the applied temperature conditions. (In the cases hereafter referred to the volume proportions of cable and oil were such that an alteration of .0001 in. in the cable sheath diameter produced a difference of .1 in. in the datum level of the oil in the gauge glass; in other words, an expansion of 1 mil in the cable diameter produced a rise of one inch in the graduated tube.)

In the discussion on Riley and Scott's I.E.E. paper on "Insulating Oils for High Voltage Cables,"[11] the writer showed that in a given case a 0.15-sq. in. 33-kV diatrine impregnated three-core belted-type cable, perfectly elastic behaviour was consistently indicated on the above mentioned basis when the cable—under the conditions described above—was subjected to repeated daily and weekly cycles of heating and cooling, the steady temperature conditions during heating being appreciably higher than maximum operating temperatures. Further experiments have since been conducted on other sample lengths of cable, in which the temperature conditions

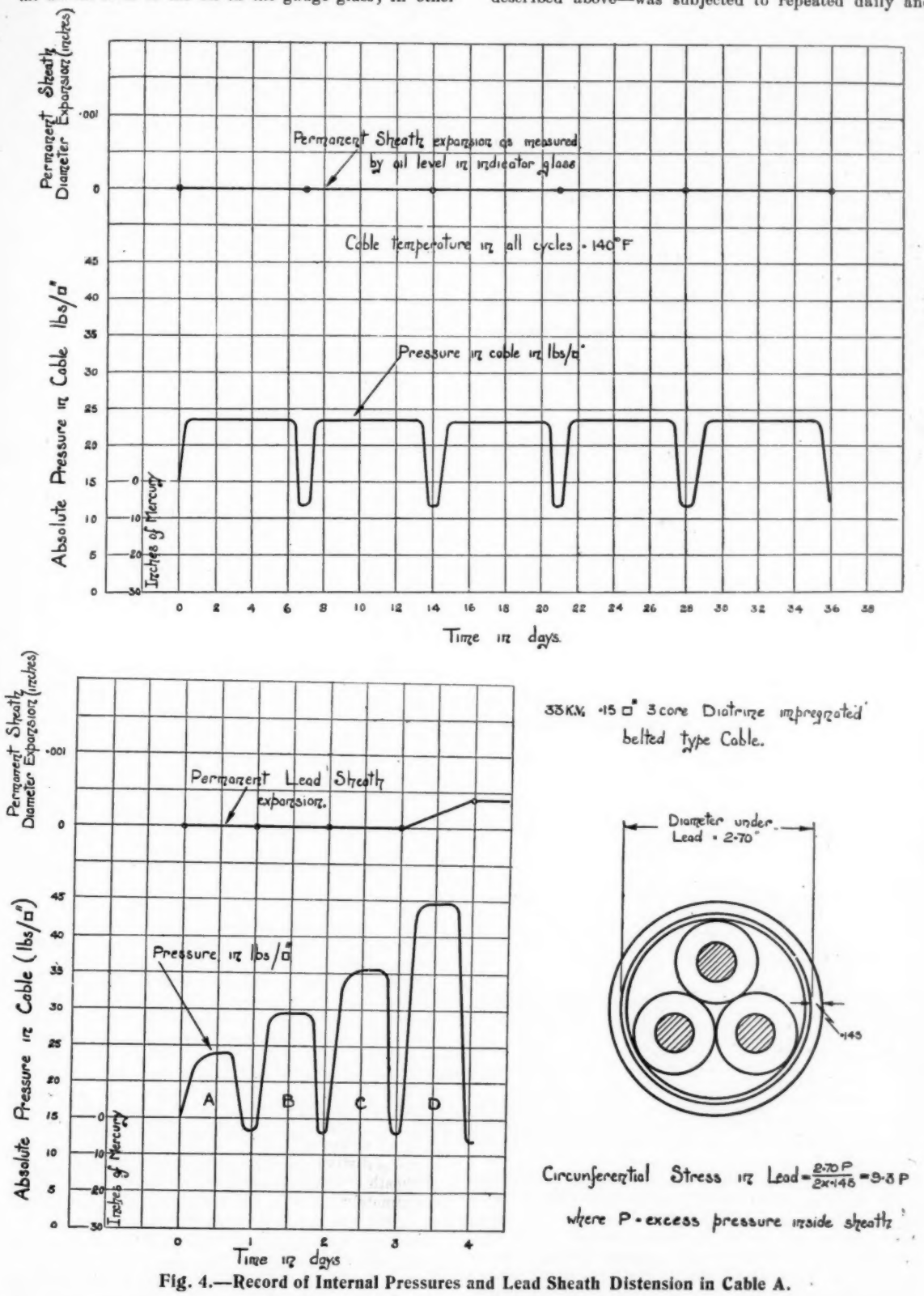

Permanent Sheath Diameter Expansion (inches)
Permanent Sheath expansion as measured by oil level in indicator glass
Cable temperature in all cycles = 140°F
Absolute Pressure in Cable lbs/□"
Pressure in cable in lbs/□"
Inches of Mercury
Time in days
Permanent Lead Sheath expansion.
Pressure in lbs/□"
A
B
C
D
33 K.V. ·15 □" 3 core Diatrine impregnated belted type Cable.
Diameter under Lead = 2·70"
·145
Circumferential Stress in Lead = 2·70 P / 2×·145 = 9·3 P
where P = excess pressure inside sheath

Fig. 4.—Record of Internal Pressures and Lead Sheath Distension in Cable A.

[11] *Ibid.*

have been raised to values at which the corresponding internal pressures *have* produced permanent distension of the lead sheath. Positive evidence has thus been obtained as a check on the negative results above referred to.

Fig. 4 gives data relating to a diatrine (prior) impregnated three-core belted-type cable, and fig. 5 records corresponding data for a three-core H-type cable made by the vacuum (*en masse*) process. For easy reference the former will be called cable A, and the latter cable B. It will be noted that for the purpose of the experiments the difference in type—belted or H—is immaterial, the salient interest lying in the different effects produced internally by the different impregnating materials and dissimilar methods of manufacture. The belted diatrine cable was taken at random in the works

Höchstädter and Bowden,[13] in an article embodying a suggested specification of factory and installation tests for 33-kV cables, recommend 50 deg. C. (122 deg. F.) as the maximum temperature to which the cable should be raised for the purpose of a stability test having as its criterion a comparison of the power factor/voltage characteristics before and after heating. Presumably the temperature-range in such a test would exceed the working range, so that the maximum working temperature would be, by inference, less than 50 deg. C. (122 deg. F.).

It must also be noted that specifications of cable temperatures are usually conductor temperatures, and that in practice the lead sheath is always appreciably cooler, because of the temperature gradient which is essential to the operation of the cable, and without which the

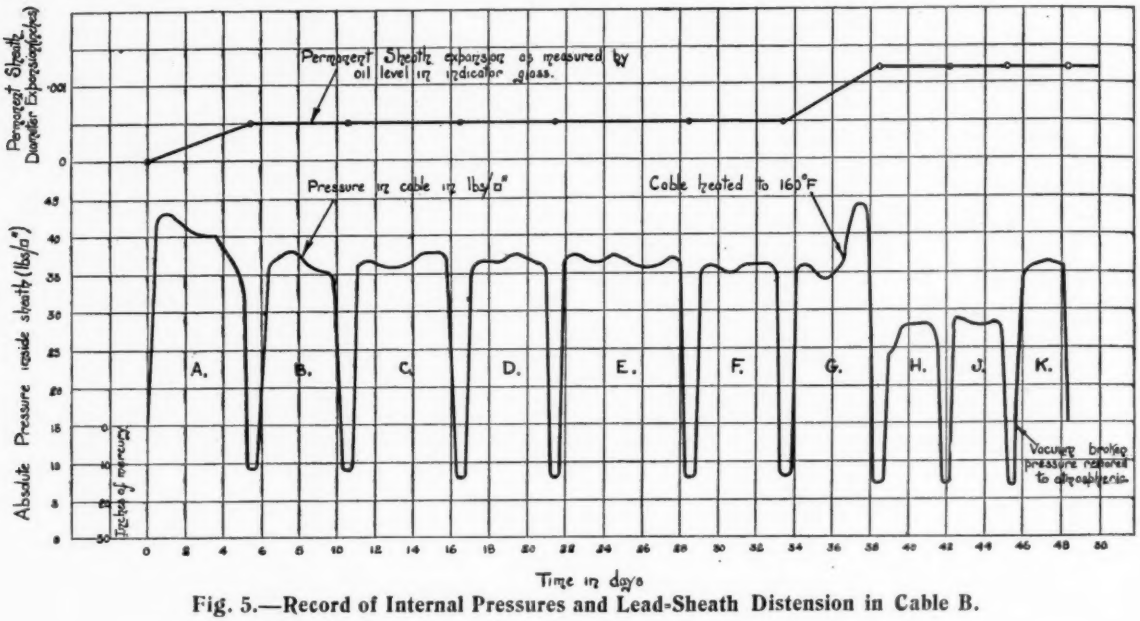


Fig. 5.—Record of Internal Pressures and Lead-Sheath Distension in Cable B.

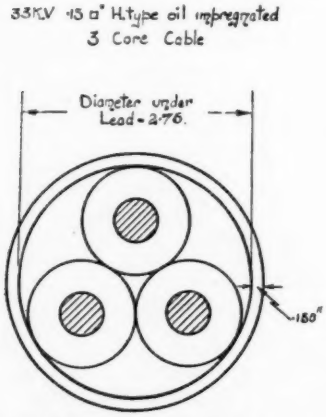


Fig. 5.—Circumferential Stress in Lead = 2·75 P/2 × ·150 = 9·2 P, where P = excess pressure inside sheath.

with which the writer is connected, and the H-type from an ordinary length made in another factory.

With regard to the various temperatures referred to in the following notes on the cycles of heating and cooling to which the sample lengths were subjected, and their relation to practical operating conditions, R. W. Gregory states[12] that "Cable makers both in this country and on the Continent are now very conservative in their figures of maximum temperature, and I doubt whether any of them would agree to 60 deg. C. on a 33-kV cable. At the present time, manufacturers of super-tension cables tend towards a maximum temperature-range of 25 deg. C., which in practice means a maximum temperature of 40 deg. C." (104 deg. F.)

[12] *Journal*, I.E.E., Vol. 66, No. 380, p. 837.

heating due to copper and dielectric losses would become cumulative, and result in the destruction of the cable. In the experimental heating runs about to be described, the cables were in no case heated to less than 140 deg. F. (60 deg. C.). Moreover, by reason of the extra expansion of the dielectric material over that of the lead sheath, the external method of heating adopted in the experiments entails appreciably more severe conditions,[14] as regards internal pressure, than those which obtain in practical operation. The theoretical deduction given in the appended footnote* has been confirmed experimentally.

Reference to fig. 4 will show that in the case of the diatrine impregnated belted cable A, after five weekly temperature cycles, during the heating periods of which a temperature of 140 deg. F. (60 deg. C.) was steadily maintained, daily cycles were carried out at increasing temperatures. Up to and including a temperature of 170 deg. F. (76.5 deg. C.)—cycles B and C—producing an internal pressure of 35.5 lb. absolute per sq. in., no permanent distension of the lead sheath occurred, but at 180 deg. F. (82 deg. C.)—cycle D—with a corresponding internal pressure of nearly 45 lb. absolute per sq. in., it was distinctly measurable. The elastic limit of the lead sheath, therefore, lies between these values and is approximately deducible from the data shown.

From fig. 5 it will be seen that the oil-impregnated H-type cable B developed an internal pressure of 43 lb. absolute per sq. in. at the first application of a temperature of 140 deg. F. (60 deg. C.), and its lead sheath sustained a slight permanent distension. This permanent set allowed successive heatings at 140 deg. F. (60 deg. C.)

[13] ELEC. REV., November 25th, 1927, p. 894.

[14] Riley, Discussion on Mercier's paper, "Notes on the 60-kV Underground Network of the Union d'Electricité." *Journal* I.E.E., Vol. 65, No. 365, p. 513.

to be applied without further alteration to the dimensions of the sheath, by reason of the resultant readjustment of the internal pressure conditions. After five more cycles of a few days each, B to F, during which the internal-pressure values consistently followed the cable temperature, an excess temperature of 160 deg. F. (71 deg. C.) was applied, cycle G resulting in a further expansion of the sheath and a further readjustment of internal pressure conditions.

Finally, after cycles H and J under conditions produced by cycle G, the internal pressure in the cable was released, and it will be seen that in cycle K the pressure range was raised so that its minimum value was approximately atmospheric, but its amplitude was the same as that of H and J—this constituting further confirmation of elastic behaviour.

These later cycles of cable B illustrate characteristic features of the internal pressure readjustments following on the production of a permanent distension of the lead sheath.

These features are (*a*) an appreciable reduction in the amplitude of the pressure variation over the temperature range, and (*b*) lowering of the pressure range —consequent upon (*a*)—such that the maximum pressure is appreciably lowered with little corresponding effect on the minimum pressure. This relief to internal pressure—and consequently to stress in the lead sheath —clearly precludes the possibility of the expansion of the lead sheath (to which it is due) being cumulative, as Höchstädter and Barrat[15] purport to show. Further, the manner of the effect of (*a*) on (*b*), *i.e.*, by lowering the maximum pressure of the newly established range without appreciably affecting the minimum, avoids the production of a high vacuum, which is contrary to the popular idea.

Comparison of the characteristics in the two cables A and B brings out two main points. Firstly, that for a given degree of heating the amplitude of the pressure range is considerably lower in cable A than in cable B, and this would appear to be due to the lower coefficient of expansion of the impregnating medium; the actual relation is nearly 1:2. This advantage is, of course, due to the prior impregnation process, which allows a practically free hand with regard to the physical properties of the impregnating medium. Secondly, as regards the internal pressure values (and consequently the sheath stress values) required to produce permanent distension of the lead sheath, there is good agreement between the two cases, as exemplified in figs. 4 and 5.

It should be noted that while the order of amplitude of variation of pressure in each case represents that which would obtain in practice (because the pressures depend on the specific properties of the different impregnating media), this is not necessarily the case with regard to the position of the range of absolute pressures concerned. In factory lengths of the vacuum-impregnated type represented by cable B, the range is likely to have a lower datum level than the approximately atmospheric pressure which will obtain in the prior impregnated cable A. This is due to the fact that ordinary vacuum-impregnated cables are normally sheathed while hot, and as pointed out by Emanueli,[16] the subsequent contraction on cooling tends to produce "empty spaces." In actual practice a vacuum of several inches is often measurable in cables of this type, even after being put into service. This disadvantage is avoided in the prior impregnated type, because the cable is at approximately atmospheric temperature when it enters the lead press.

From the aspect at present under review, however, the effect of lower initial pressure is to provide a greater margin for the avoidance of the critical stress at which the lead sheath suffers permanent distension. In the tests recorded in figs. 4 and 5, the two samples were necessarily—by reason of their short length and the conditions of their preparation—on approximately level terms with regard to initial pressure, so that as regards their respective pressure ranges, the absolute values for cable B were probably higher than would exist in practice, while those for cable A would be approximately normal. The foregoing is simply noted in the interests of practical accuracy, the point of real importance being that already noted, *viz.*, the agreement regarding internal stress conditions necessary to produce permanent distension of the lead sheaths.

(To be concluded.)

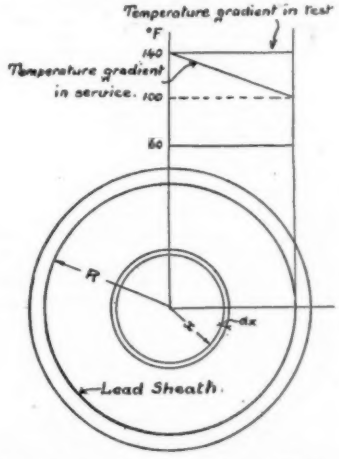
[15] *Ibid.*

* The difference between the temperature gradients in the test and under actual service conditions is shown in the figure below, where R = inner radius of lead sheath, and L = length of sheath in the same units.

Now, the volumetric coefficient of thermal expansion of the lead sheath = 0.000047 per °F.

The increase in the lead sheath volume due to heating it to 140° F. instead of 100° F.

$$= \pi \, R^2 L \times (140 - 100) \times 0.000047 = 0.0059 \, R^2 L.$$



Now, taking a low value of 0.0001 per °F. for the thermal coefficient of expansion of an impregnated paper dielectric, the increase in the expansion of the dielectric due to the difference in the temperature gradients—

$$= \int_{x=0}^{x=R} 2\pi x L \, dx \times \left(\frac{x}{R} \cdot 40\right) \times 0.0001 = 0.0084 \, R^2 L$$

which is greater than the corresponding extra expansion of the lead sheath, and hence a larger internal cable pressure is produced under the test than under the service conditions.

[16] *Ibid.*

A Speed-Variation Scheme.

As a means of obtaining speed variation for a temporary job, the author suggests employing a slip-ring motor as a frequency changer for supplying the driving motor.

By G. F. HEATH.

ONE of the few disadvantages of the induction motor is that its normal operating speed is definitely fixed by the number of poles contained in the stator winding and the frequency of the supply, according to the well-known formula:

Revs. per min. (synchronous) = (cycles per second × 60)/number of pole pairs in stator winding.

The speed of any slip-ring induction motor can, of course, be reduced by inserting external resistances in the rotor circuit, and, in the case of an ordinary squirrel-cage machine, by resistance in the stator circuit, but both these methods are inefficient, the latter obviously, whilst with the slip-ring motor there is practically no difference in the power input to the stator at

normal and reduced speeds, as the energy corresponding to the difference in output is dissipated in the form of heat generated in the resistances. There are several types of variable-speed a.c. motors manufactured, but the cost of each is relatively high, compared with that of the induction motor, and for this reason they are usually only installed for specific duties where induction motors would not serve the purpose. The case often occurs in practice where a motor possessing a wide range of speed variation is desirable, but the temporary nature of the work does not warrant the purchase of a variable-speed motor, and owing to the frequency of the supply and the polarity of the available induction motors, the desired range of speed may be thought unattainable; it is in such a case that a slip-ring induction motor can be used, with advantage, as a frequency changer to drive another induction motor, the speed of which can be varied within very wide limits.

When a two- or three-phase a.c. supply is switched on to the stator of a suitable induction motor, a rotating magnetic field is set up around the stator core, the speed of rotation being the synchronous speed of the motor. If the rotor is held stationary, this rotating field will cut the conductors therein and, assuming the usual practice of the rotor possessing an equal number of phases and poles as the stator, it will induce a voltage having similar characteristics of phase and periodicity as the supply in these conductors. Further, if the rotor revolves at the same speed and in the same direction as the stator's magnetic field, the latter will not cut the rotor conductors and, in consequence, no voltage will be generated, whilst at any intermediate speed of the rotor, the periodicity of the induced voltage will depend upon the difference in speed between the stator's revolving field and the rotor conductors. If the rotor is driven mechanically in a direction opposite to that of the stator's field, the speed of rotation of the latter, relative to the rotor conductors, will be greater than when the rotor is held stationary, so that frequencies lower than that of the supply can be obtained when the rotor revolves in the same direction as the stator's field, and higher, when the rotor is driven against this field. The synchronous speed of any induction motor connected to the slip-rings of the mechanically-driven rotor will therefore depend upon the speed and direction of rotation of the latter, the frequency of the rotor voltage being given by the formula:—

$$f_R = f_S \left\{ \frac{(\text{R.P.M.}_S \mp \text{R.P.M.}_R)}{\text{R.P.M.}_S} \right\}$$

where f_R = frequency of rotor voltage.
" f_S = frequency of stator voltage (*i.e.*, of the main supply).
" R.P.M.$_R$ = rev. per min. of rotor.
" R.P.M.$_S$ = synchronous speed of motor (or speed of stator's rotating field).

The − sign is employed when the direction of rotation of the rotor is the same as that of the stator's magnetic field, and the + sign when the rotor is driven against the field.

Perhaps one or two examples will make the above formula more clear; let us take the case of a 6-pole slip-ring induction motor, and a supply at 50 cycles per second. The synchronous speed of this motor would be:—R.p.m. (synchronous) $= 50 \times 60/3 = 1{,}000$ r.p.m. Let us drive the rotor in the direction in which it would run normally (with the stator's rotating field) at 600 r.p.m.

The frequency of the voltage induced in the rotor would then be given by:—

$$f_R = 50 \times (1{,}000 - 600)/1{,}000 = 20 \text{ cycles per sec.}$$

With the same motor and supply, let the rotor be driven against the stator's field at a speed of 200 r.p.m.; the rotor frequency would then be:—

$$f_R = 50 \times (1{,}000 + 200)/1{,}000 = 60 \text{ cycles per sec.}$$

For a required frequency of rotor voltage, the necessary speed of the rotor can easily be calculated; it should be noted that for a frequency either below or above that of the supply, two speeds would give the same result, one above and the other below the synchronous speed of the slip-ring motor; for instance, suppose a frequency of 60 cycles were required:—

$$60 = 50 \times (1{,}000 + \text{R.P.M}_R)/1{,}000 \quad \therefore \text{R.P.M.}_R = 200$$
$$60 = 50 \times (\text{R.P.M.}_R - 1{,}000)/1{,}000 \quad \therefore \text{R.P.M}_R = 2{,}200$$

The lower speed would naturally be used.

The question now arises as to the amount of power required to drive the rotor of the induction motor at the necessary speed. As long as the rotor is driven in the same direction as the stator's rotating field, the amount of power required of the driving motor is that taken from the slip-rings by the other motor, plus the copper losses which occur in the slip-ring rotor windings. When the rotor is driven against the stator's field, a certain proportion of the output is supplied by the slip-ring motor, which acts as a transformer, the remainder coming from the driving motor. An example best illustrates this:—

Using the same slip-ring motor and supply, let us assume that we desire a 4-pole squirrel-cage motor to run at a synchronous speed of 2,100 r.p.m. The necessary frequency is:—

$$f_R = \frac{(\text{R.P.M.} \times \text{pole pairs})}{60} = \frac{2{,}100 \times 2}{60} = 70 \text{ cycles per sec.}$$

This frequency is higher than that of the main supply, and the slip-ring rotor will therefore have to be driven against the stator's field:—

$$70 = 50 \left\{ \frac{(1{,}000 + \text{R.P.M.}_R)}{1{,}000} \right\} \quad \therefore \text{R.P.M.}_R = 400.$$

The total power taken from the slip-rings would therefore be contributed in the proportion:—

$$\frac{1{,}000}{(1{,}000 + 400)} = \frac{5}{7} \text{ by the transformer action of the slip-ring motor;}$$

$$\frac{400}{(1{,}000 + 400)} = \frac{2}{7} \text{ by the motor driving the rotor.}$$

It is not suggested that this method of frequency changing should be employed to obtain a special speed from a large unit in constant use; doubtless this case would be better met by the purchase of a special motor, or, if the required speed was reasonably near and below the maximum synchronous speed directly obtainable from a slip-ring motor, by reduction of the speed through the use of resistances in the rotor circuit; however, it would be of interest to ascertain the effects of variation of frequency upon an induction motor.

The fundamental equation for any a.c. machine is:—

$$E = (K\phi Z f)/10^8$$

where E = volts per phase, ϕ = flux per pole, Z = conductors per phase, f = frequency, K = a constant.

If, therefore, the flux and the frequency are variables, the former will vary inversely as the frequency,

i.e., ϕ varies as $1/f$.

In the case of an induction motor, the torque varies directly as the flux, so that if the frequency is doubled, the synchronous speed of the motor is doubled; but the flux, and therefore the torque, is halved, so that the motor output is theoretically unaltered. The decreased flux at the increased frequency will result in a decrease in the magnetising current, and since there is practically no change in output, this will result in a higher power factor, whilst the stator copper losses will probably be decreased. It is, of course, necessary to remember that the centrifugal force to which the rotor components are subjected varies as the square of the speed, so that doubled speed means quadrupled centrifugal force.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A New Wall Socket and Plug.

In order to meet a demand for a 5-A wall socket and plug of somewhat smaller dimensions than the usual type, the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, has placed on the market an attractive accessory, fig. 1, which complies, it is claimed, in all respects with British Standard Specification No. 73-1927. The socket is designed to supersede the company's 5-A old pattern, which measured 2¼ in. in diameter, with 1¼-in. projection. By a re-arrangement of the tubes and terminals, the new socket, which is of English vitreous porcelain with a polished bakelite drop-on cover, measures only 1⅛ in. in diameter, with ¾-in. projection. The new socket has a much neater appearance than its predecessor, with a perfectly smooth surface devoid of dust-collecting ridges. The plug is also an improved type. Its

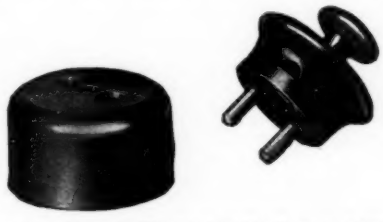


Fig. 1.—New " Magnet " Socket and Plug.

chief features are solid hexagonal terminals and circular pins (turned from the hexagonal bar); terminals bedded in recesses moulded into the bakelite disk (replacing the orthodox fibre disk); and a Home Office pattern hand-shield top which can be rotated to four positions, for reception of the disk, and therefore allows for any one of five different sizes of flexible to be connected and gripped externally between the disk and cover.

A Battery Hydrometer Set.

An American production for which Messrs. FREDK. J. GORDON AND CO., LTD., 92, Charlotte Street, W.1, have been appointed sole agents for the British Isles is the " Break-Not " battery tester, fig. 2. The bulb and tip of the container are made of good-quality red Para rubber, and the capacity is such

Fig. 2.—Hydrometer Outfit.

Fig. 3.—" Elect " Ambulance Urn.

as to prevent spilling. Provision is made for hanging the apparatus up—tip upwards—and also for preventing it from rolling. The hydrometer proper is claimed to be scientifically accurate, and it is printed in three different colours to facilitate reading. Other claims for the apparatus are that it contains much less glass than some models, that it will not leak, and that the hydrometer itself will not stick.

New Lighting Fittings.

PHILIPS LAMPS, LTD., 145, Charing Cross Road, W.C.2, are introducing a comprehensive range of new commercial and industrial lighting fittings. Some of the commercial fittings will be known by the trade name of " Phililite," and the accompanying illustration, fig. 4, shows type " DB," which is made in two sizes, suitable for 40-100-W and 100-200-W lamps, respectively. The advantages claimed for " Phililite " fittings are: ease of erection, they are sent out wired complete and only one screw need be tightened to secure the bowl to the gallery; very low light absorption, three-ply glass being used; the chain suspension is of a new patent design, both

Fig. 4.—" Phililite " D.B. Fitting.

attractive in appearance and essentially practical; and it requires only a few moments to remove or add links for the purpose of shortening or lengthening the chain.

An Ambulance Urn.

An electric urn, recently introduced by the ELECTRIC HEATING Co., George Street, Croydon, is designed to meet the demand for a small appliance for emergency use in ambulance stations. This, " Elect " urn, fig. 3, has a low loading of 100-200 W, so as to allow a steady 24-hour service of water, and its water capacity is half a gallon. The apparatus is constructed of stout copper sheet, and is highly polished.

A Cable-laying Machine.

Included in the uses for which a mole plough recently introduced by the AUTO-MOWER ENGINEERING CO., LTD., Norton St. Philip, near Bath, is claimed to be suitable is cable laying. When used for this purpose the mole is equipped with a special connection by means of which, should an obstacle be encountered, the mole automatically releases itself from the cable and rises to the surface. The size of the mole and the working depth can be varied according to requirements. The plough works in conjunction with a tractor on the cable-haulage principle, special anchoring arrangements being provided for the tractor. This is equipped with a 20-h.p., 4-cylinder, water-cooled engine.

A Brush and Commutator Trouble Chart.

A " Carbon brush maintenance and trouble chart " which is being issued by MARTINDALE ELECTRIC CO., LTD., The Hyde, Hendon, N.W.9, should prove useful to motor-maintenance men. It shows in readily discernible form the causes of brush and commutator troubles, and also the effects and evidence of such troubles.

Submarine Signalling.

Messrs. Schneider & Co., of Le Creusot, France, have recently secured the French rights in the new system of signalling developed by the Submarine Signal Corporation, of New York. It is stated that the system enables acoustic signals to be transmitted and received from below the surface of the sea, also enabling the direction and distance of the source of the signals to be determined.

Electric Cooking and Heating Developments.

The Fourth E.D.A. Salesmanship Conference of the 1928-29 Session.

AT the Salesmanship Conference of the Electrical Development Association held at the Royal Society of Arts on January 18th, Mr. C. H. Rayner, sales manager to the Manchester Corporation Electricity Department, read a paper in which he dealt generally with recent developments in electric heating and cooking, with special reference to what has taken place in Manchester. Captain J. M. Donaldson (North Metropolitan Electric Power Supply Co.) was in the chair.

Mr. RAYNER said that it was not until 1908 that cumulative records were taken of the heating appliances connected to the Manchester mains, the number then being 643. Ten years afterwards the figure had grown to 5,353, whilst to-day it was 43,500. The cooker hire scheme was inaugurated in June, 1923, and at the end of that year there were 173 hired cookers installed. The number, however, had been steadily increasing at the rate of 18 or 20 per week, and at the present time, including a small number of privately-owned appliances, 5,500 cookers were connected, aggregating 33,665 kW. A fairly comprehensive review was given of the early difficulties associated with the manufacture of heaters, and Mr. Rayner said that modern heaters were thoroughly reliable and cheap to buy and operate. He referred to a system which was about to be introduced into this country by which energy was supplied at 6,600 V to electric boilers for heating large buildings and for factory processes, a system which, if successful, would undoubtedly help towards the night use of electric water-heating appliances during off-peak hours. Indicating some special uses for small heaters, Mr. Rayner mentioned that a certain firm in the Midlands was at present carrying out a contract for some hundreds of feet of heating tubes to be used on the covered top decks of the cars owned by an important tramway undertaking. In Manchester, also, as in some other towns, 600-W heaters were being installed in the police boxes. A useful loading for space heating in public places such as theatres, churches, &c., was 0.6 to 1 watt per cubic foot of space. In sitting rooms and similar apartments, a more liberal allowance was desirable, and 1.25 or even 1.5 watts per cubic foot would generally be found to be required in order to provide a comfortable heat at short notice. The amount of window space and construction of the window frames had to be taken into account. A favourite and apparently effective position for tubular heating was a few inches from the floor immediately under the window as by this means any current of air coming through crevices in the window frames was heated as it entered the room. Finally, Mr. Rayner said that there was a considerable field for activity in electric heating, and a large amount of business might confidently be anticipated in the near future as the result of the efforts now being put forward by makers of appliances.

Passing to electric cooking, the speaker pointed out that manufacturers had recently made important improvements in construction, particularly as regarded hot plates, the disposition of switches and fuses, the enamelling of hobs and oven interiors, and a more pleasing and convenient design. Although it could not be said that the perfect electric cooker had yet been evolved, we were well on the way towards it. There was still room for speeding up hot-plates, which was perhaps the most pressing need of the moment. Much could be done, however, to educate the user in this matter by stressing the importance of slow boiling and steam cooking. Much controversy had centred around the respective merits of the open and closed types of hotplates, but the verdict appeared to be decidedly in favour of the latter. Discussion was still being carried on with regard to top and bottom heat or side heat in the opens. In the northern districts where so much bread baking was carried out in the home, bottom heat appeared to be popular, but the inclination of the cook was the deciding factor as a rule.

Speaking of tariffs, Mr. RAYNER suggested that the most popular one was the two-part tariff, for both domestic and industrial purposes. A special "all-in" tariff had been adopted in Manchester which consisted of a yearly charge of 20 per cent. on the 1914 or equivalent ratable value of the property plus ½d. per kWh for all energy consumed. Although it might not be perfect it formed a convenient and fairly equitable method of assessing the standing charge to meet the fixed costs of supply, and its popularity in Manchester was seen in its adoption by 8,500 consumers. By this system of charging, consumers were encouraged to make full use of electricity for all purposes and average costs of 0.6d. to 0.7d. per kWh were common figures.

In a final review of the factors entering into the sale of electric cooking and heating appliances, the advantages of showrooms and demonstrations in the home were emphasised, but greatest stress was laid upon the disinclination of architects and builders to design houses with sufficient outlets for electric heating and cooking. It was suggested that the E.D.A. should take up the question of lectures before the architects' and builders' societies and institutions.

The attendance at the meeting was unusually large, and there was a lengthy discussion; we give below a summary of the principal points.

Discussion.

Major GRIERSON said it would be interesting to have figures of the revenue per domestic consumer in various parts of the country because these would emphasise the importance of encouraging the further uses of electricity beyond mere lighting. It cost just as much for a meter reader to read the meter of a consumer using 7s. 6d. worth of energy as one using £20 worth. Speaking of the general development of heating and cooking, he said that confidence was the root of the business. From this point of view he supported the ratable value method of charging because the consumers could understand it, whatever its defects might be. Nothing created distrust more than a system of charging so complicated that the supply authority often could not give a simple explanation. On the same question of confidence, he mentioned several instances in which consumers had been asked to pay, as a lump sum, amounts varying from £210 to £450 before the supply could be given. There was no question of a percentage on the cost of the main spread over a period of years; it was a definite lump sum payment without any indication as to how it had been arrived at. In one case, when it was ascertained that the probable maximum demand was 15 kW more than had been stated at first, the original figure of £140 had been increased to £210. What was the use of all the propaganda of the E.D.A., if that sort of thing went on?

After advocating a low running charge—not more than ½d. with, if necessary, a higher fixed charge—Major Grierson spoke on the need for standardisation of consumers' voltage throughout the country, the absence of which was often a deterrent to people buying electrical apparatus which they knew would be useless when they moved to another district.

Mr. GREGORY expressed the view that the standing charge in the two instances mentioned by the author was too low, and doubted whether they really covered the actual fixed charges involved.

Mr. HOWELL suggested that there had been little improvement in electrical cooking apparatus for a number of years, and suggested that more good would come from standardising voltage before apparatus. He asked how many electrical people adopted electric cooking. It was impossible to be convincing to a potential user of electric cooking if one did not use the apparatus. Manchester seemed proud of its 5,500 hired electric cookers in five years, but how many gas cookers had been installed in the same period? In conclusion, Mr. Howell defended the supply authorities' making charges for laying cables to give a supply, and mentioned a similar complaint in his own area which, however, concerned a block of flats held on monthly tenancies; one person who asked for a supply and was told that he must contribute £15 towards the main, had admitted that he proposed to move as soon as he found a suitable house elsewhere. Yet he complained of the demand of the supply authority.

Mr. BROWN (Hackney) analysed the figures given in the author's examples, and suggested that the actual overhead charges and maintenance on an average cooker installation plus the cost of the energy would only just balance the fixed charge made, so that electricity was really being supplied free of charge.

Mr. STEELE, as the owner of an all-electric house, said that it was unnecessary to have a running charge of ½d. per kWh. His total cost was 1.1d. per kWh, and he was quite satisfied that he was doing his cooking, heating, lighting, and everything else more cheaply than he could by any other method.

Mr. JACKSON said a difficulty was experienced in getting cookers put in where the consumer had to pay an initial sum of £5 on account of installation. One undertaking in London included in its hire charge free installation.

Mr. WATTS (Epsom) expressed the view that electric heating and cooking development depended mainly on the tariff. The ratable value and similar tariffs were extremely useful and he was thinking out a three-part tariff. He did not think a charge of ½d. per kWh need be made, as a higher figure would often get the business. In the case of two small housing estates in his area the average revenue per consumer through slot meters was £10 per annum.

Mr. BIRKS said he represented a small supply company purchasing its energy in bulk, but the charge made to him for the

bulk supply was such that he could not recommend his consumers to adopt electricity for continuous heating. In such cases as his own, it was necessary to reduce the maximum demand of the cooker owing to the time this load came on, and he suggested that there would be no hardship to the consumer if the wiring of the cooker was so arranged that the grill could not be switched on at the same time as one of the hot plates. This would reduce the demand and perhaps save £1 per annum in the fixed charge.

Several speakers referred to the advantages of electric cooking, and the suggestion was made that supply authorities should place bulk orders for cooking and heating apparatus in order to get lower prices.

Lt.-Col. W. A. VIGNOLES (Director, E.D.A.) reminded the meeting that these conferences were Salesmanship Conferences and that the tendency for one side to blame the other for lack of development was beside the point. The thing to be done was to apply salesmanship to the selling of heating and cooking apparatus, because electricity would not sell itself. He was living on a new housing estate which had been wired in a most up-to-date fashion, but there were not a dozen electric cookers among the 200 or 300 houses. When he first went there he was immediately approached by the gas company with an offer to do anything for him, and it was undoubtedly the keenness of the gas company in getting in gas cookers and other apparatus before the householders were approached by the electricity supply people that had brought about that position. Therefore, salesmanship and good organisation were necessary. The only two things which the gas interests could allege against electric cooking was high price and slow boiling, but it was not difficult to refute those arguments and, at the same time, produce such points as the danger to health from the products of combustion from a gas oven in a room and the general danger of gas. The E.D.A. was considering how to approach architects and builders with regard to a larger number of points in new houses.

The CHAIRMAN remarked that those who said there had been few improvements in electric fires and cookers during recent years could not be aware of what had really taken place. He himself had been using electricity for cooking for 20 years, and although at one time there was always something going wrong, to-day he hardly ever had to touch anything and he was using 20,000 kWh per annum.

Mr. RAYNER, in the course of a brief reply to the discussion, said that if the fixed charge at Manchester was too low the re-assessment of premises under the new Act would put that right. At the same time, it must always be borne in mind that something must be allowed for propaganda and frequently, by virtue of low charges, other apparatus was installed which would not otherwise be used.

Reviews.

An Introduction to the Theory of Eddy-Current Heating. By C. R. BURCH and N. RYLAND DAVIS. Pp. 72; figs. 15. London: Ernest Benn, Ltd. Price 12s. 6d. net.

This little book is remarkable in several respects. It is, indeed, scarcely a book, but rather a very limited monograph, since it deals only with furnaces of the coreless type, eddy current furnaces in which iron cores are used being curtly dismissed in a dozen lines. The reason is obvious. The coreless type of furnace lends itself to an intensive mathematical treatment which the varying permeability of an iron core would render far more complicated, if not altogether unmanageable. So, having first disposed of this troublesome core, the authors can proceed to handle the remaining problem with all their mathematical skill, displaying in the process a wide knowledge of functions and much ingenuity in exploiting them. Such work is significant, as being a mark of that new school of University trained men now appearing in the engineering industry, and in this respect the book is an augury.

Chapter II contains the theory of induction heating and begins with an argument from dimensions alone wherefrom a relationship is deduced between the power dissipated by an induction furnace, the linear dimensions and resistivity of the heated material and the so-called "pulsatance" of the applied field. Why the authors adopt the hideous word "pulsatance" for $2\pi f$ is unexplained. It is to be hoped that others will not follow their example. Then ensues a literal transcript of the paper published two years ago, which is developed in some detail, but ultimately leads to the former conclusion that for high efficiency the external radius of the charge is dependent upon the ratio $\sqrt{\rho/f\mu}$, where ρ is the specific resistance of the charge, μ its permeability, and f is the frequency of supply.

The next chapter, dealing with such matters as the optimum dimensions of the inductor and the charge, arrives at the general deduction that the length of the inductor should be about equal to the diameter. Academic exercises are here indulged in concerning such problems as the heating of a magnetic sphere, the corrections for short inductors, &c. Early in Chapter IV consideration is given to practical matters, such as the state of division of the charge, but later the attention devoted to hollow charge formulæ seems out of all proportion to the importance of the subject. The chapter concludes with a short but useful discussion of heating by non-periodic currents and of magnetostriction.

In the final chapter the design problem is approached, and here the few conclusions gleaned from the mathematical investigation are to some extent used as a basis. The determining parameters are stated to be frequency, thickness of lagging and inductor length and turns per cm. But the chapter is somewhat unconvincing and breathes the air of uninvestigated compromise. The work concludes with an interesting comparison between prediction and test upon a small furnace.

It has been said that the book is remarkable as showing a tendency of modern engineering education. It is also remarkable for the price at which it is published. Twelve shillings and sixpence is high for a book of 72 pages, with 14 diagrams and no index, especially when the most useful part of the work has been previously published. To justify such a price, conclusions should be reached of great novelty and importance. The reader may reasonably ask whether the results vindicate the long and intricate mathematical work involved. We think that the answer is in the negative; and our conclusion is supported by the few deductions available for use in Chapter V. But there is a third direction in which the book is remarkable, *viz.*, in its omissions. No engineer has done so much to develop coreless induction heating as E. F. Northrup, and, indeed, the authors in a footnote refer to two of his early patents. Yet they omit all reference to Specification No. 243,694, bearing the convention date 1924. Surely they must have been aware of its existence, since it antedates some of their own work by two years. In it is to be found a discussion of the chief factors upon which the design of a coreless induction furnace depends, together with an example showing the application of the principles. It is true that Northrup's mathematical methods are by comparison crude and elementary, but he should at least be given credit for first developing many important relationships and especially those existing between radius of charge, specific resistance and frequency. Other omissions of a similar kind may be quoted. For example, there is no reference to Northrup's article in the *General Electric Review* of November, 1922, nor to his Specification No. 247,519 of 1925. The last is of importance as giving the second relationship arrived at by the present authors, *viz.*, that the diameter and height of the inductor should be about equal; and it also deals fully with the economical size of condensers. Such omissions suggest uncomfortable reflections on the fact that Messrs. Burch and Davis are employed by a firm presumably in commercial competition with Northrup's Company. But surely text-books should be above such rivalry, and we prefer to believe that these lapses are due to ignorance of the documents quoted, rather than to commercial exigencies.

The book is well produced, and on the whole remarkably free from misprints. The authors should, however, have known that Professor Elihu Thomson does not spell his name with a "p."

Elements of Alternating Currents and Alternating Current Apparatus. By J. L. BEAVER, E.E., M.S., Associate Professor of Electrical Engineering, Lehigh University. Pp. xii+393; figs. 309. London: Longmans, Green & Co. Price 18s. net.

The first eight chapters of this book deal with the principles of alternating currents and the laws governing the flow of such currents. The remainder of the book is chiefly concerned with an account of alternating current machines, though the two final chapters deal with instruments and transmission lines respectively.

The standard of treatment can be conveyed by stating that the book deals with the subject to a much greater extent than is necessary for the purpose of the Ordinary National Certificate, but not so deeply as would be required for a Higher National Certificate or for a full-time day course in our universities or large technical colleges.

A characteristic of the early chapters is the great detail with which elementary problems of current flow are considered. A particularly interesting feature is the attention given to the symbolic method of treatment (though no great use is made of the method in the later parts of the book), and this necessitates the introduction of the ideas of conductance, susceptance and admittance to a much greater extent than is usual in books of this type.

The treatment of transformers, synchronous machines, induction motors and convertors, in the later portions of the book, while adequate for the end in view, is broader and less detailed.

The book is accurately written, though on page 261, when dealing with the synchronising of three-phase machines, we find a statement to the effect that one disadvantage of a lamp synchronising device is that it gives no indication as to whether an incoming machine be fast or slow. As a matter of fact, it is possible to secure this indication in a very simple manner. A point of note in connection with converting plant is the omission of any consideration of the motor-convertor, a type of machine which has many advocates in this country.

The line diagrams are usually drawn with care, but the curves of power in certain wave diagrams in the early chapters are of poor shape and the lettering in certain vector diagrams is so small as to lead to indistinct reproduction.

Finally, mention should be made of the considerable collection of questions demanding descriptive answers and problems, to which numerical answers are given, with which each chapter is concluded.

D

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments. Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The "Electrical Review" Index.

The Index to Vol. CIII (for the half-year ended December 31st, 1928) is now being printed, and we shall be glad to receive the names and addresses of those who require it (free of charge) for binding purposes, or wish to retain it for reference. Application should be made to the Publisher, 4, Ludgate Hill, E.C.

New Companies in 1928.

In their annual statistical report for 1928 Messrs. Jordan and Sons, Ltd., company registration agents, Chancery Lane, W.C.2, analyse the companies registered during the past year. From this it is observed that 838 public companies and 8,174 private companies (total 9,012), with an aggregate capitalisation of £220,506,126, were formed. In 1927 8,399 companies were registered, their total capitalisation being £173,162,271. Under the heading "Electricity, gas and water" there were 29 public companies (capital £3,669,400) and 239 private ones (capital £783,221), giving a total of 268, with an aggregate capital of £4,452,621.

For Sale.

The West Central Merchandise Mart will sell by auction on January 30th, at York House, Southampton Row, W.C., stocks of electrical fittings, accessories and cables. (See our advertisement pages to-day.)

A Banker's View of Industry.

In accordance with the usual practice at the annual meetings of bank shareholders, Mr. F. C. Goodenough, chairman of Barclay's Bank, Ltd., made an interesting commentary on current financial, economic and industrial conditions in his speech last week. Regarding industry, he recalled that a year ago the prospects were more hopeful, but said that, unfortunately, expectations were not realised. There had certainly been a slight improvement in the iron and steel industries and certain allied trades, but the coal industry remained in a very bad state, as did certain sections of the Lancashire cotton industry. On the other hand, the "finishing sections" of certain industries, the "luxury" trades, and certain of the newer industries were in a much more satisfactory condition. The country was maintaining its reputation for skilled manufacture, but as yet, with few exceptions, had not proved itself to be entirely suited for mass production. This was mainly because we had not such a large home market as, for instance, the United States. Although last year our exports of manufactured goods had increased, the depression in our heavy industries was so bad as to create a general feeling that our industrial organisation was not what it should be. In his opinion, however, there were grounds for confidence in the great efforts which were being made to place the depressed industries on a more satisfactory footing through great industrial combinations. Much more was being done to develop new outlets for trade and to improve the marketing of our goods. There were still no signs of a reduction in tariff barriers if taken as a whole. Those barriers tended substantially to reduce international trade, and it seemed that if we were to regain our full pre-war volume of foreign trade, steps must be taken to reorganise upon more economical and efficient lines many of the industries which were specially subject to foreign competition. Owing to the weight of our national liabilities, it was of great importance that prices in this country should be maintained as far as possible at the present level, and that there should not be any appreciable reductions in the general level of prices or in wages, which would have the effect of increasing the real burden of the National Debt. On the other hand, it was essential in the interests of industry and trade that the price levels prevailing here from time to time should not be higher than those in other countries.

Sir Herbert Hambling (deputy-chairman), who also addressed the meeting, said that without doubt there was a better feeling between capital and labour, and there were developments along the lines known as "rationalisation." If rationalisation meant the reorganising of industry on more economical and efficient lines, then it was far better than the quack doctrine of tampering with our credit and currency system. If industrial peace and rationalisation continued he was optimistic with regard to the future.

New London Showrooms.

New showrooms were recently opened by Messrs. Best and Lloyd, Ltd., at 40, Great Marlborough Street, W.1, and an informal "house-warming" was held on January 17th. The new premises, which consist of two floors of considerable length, have been designed by Mr. V. O. Rees, A.R.I.B.A. The frontage has an attractive appearance and is in black mahogany, the company's title being in bold red lettering on a glass background, which can be illuminated. The tasteful interior decorations include cream pilasters, warm grey canvas walls, brown grey hangings, and carpet, with a black border. As is natural with a firm that specialises in lighting fittings, these predominate, and the display covers almost every type of fitting. In the front of the showroom, on the top floor, installations of the modern type are shown, and models of fittings installed in various public buildings are interesting examples of the company's products. One of its specialities is "Firelight" glass, which is tinted a delicate orange merging into amber, giving a pleasing light. At the rear of this floor period fittings of many designs are shown. A prominent development is the "Ripplera" electric fire, which gives an impression of great heat by passing light through bubbling water. The lower floor is set apart for the display of fittings of a more general type, and two storerooms are also included. The showrooms are in the charge of Mr. H. S. Benwell, London manager for the company.

An Electrical Carnival.

An Electrical Carnival is being promoted in Newcastle under the auspices of the Electrical Development Association and the Electrical Association for Women. It will be held in the Oxford Galleries, New Bridge Street, Newcastle-upon-Tyne, on Thursday, February 7th, and the guests will be received by the Lord Mayor and Lady Mayoress. We are pleased to hear that the function promises to be a most successful electrical effort, and that a large number of firms manufacturing electrical apparatus have together very generously provided a large selection of prizes. These will be awarded for treasure hunts, treasure dances, balloon dances, and many other novel competitions that have been arranged for the night. The surplus moneys from the carnival will be given to the Hospitality Fund of the Electrical Association for Women to entertain the delegates at their Conference at the North-East Coast Exhibition. We understand that there is a big demand for tickets (5s. each). Mr. W. F. T. Pinkney, of Carliol House, Newcastle-on-Tyne, is chairman of the E.D.A/E.A.W Dance Committee.

Conditions in Sweden.

The *Swedish Economic Review* says that during the third quarter of 1928 the average employment figure was "better than moderately good." The mechanical and electrical industries showed a slight decline in comparison with the second quarter, but can still be included among the branches of industry in which employment is best. The exports of electrical machinery during the first ten months of the year were valued at 36,692,000 kr. (about £2,000,000), as compared with 25,899,000 kr. (about £1,430,000) in January-October, 1927. The exports of telephone and telegraph apparatus rose from 7,217,000 kr. (about £390,000) to 11,144,000 kr. (about £600,000).

Cable-Selling Concentration in Belgium.

It is announced that the company known as Les Fils Isolés Belges, of Brussels, has entered into arrangements with native producers of cables and insulated wires for the sole sale of a part of their production. The firms concerned are the S.A. des Ateliers de Constructions Electriques de Charleroi, the Société Belge pour la Fabrication des Cables et Fils Electriques, of Brussels, the S.A. Manufacture de Cables Electriques et de Caoutchouc, of Eupen, the S.A. Cablériès de Seneffe, of Seneffe, and the S.A. Cablériès et Corderies de Hainaut, of Dour.

Bankruptcy Proceedings.

C. H. MARCHANT, 42, Ashdown Road, late of 9, South Street, Tarring, Worthing, Sussex, electrical engineer.—The public examination of this debtor was held on January 16th at the Court House, Brighton. The debtor presented a statement of affairs showing liabilities of £887, against assets of £39, and he stated that he entered into a partnership with another in July, 1926. Each provided £60 capital, the debtor borrowing his share from his father. The business was a failure, and the partnership was dissolved in 1927. The partners divided the stock between them, each receiving about £10 worth, and the partner took over the liabilities, amounting to about £5. In June, 1927, the debtor entered into an agreement with another, commencing as wireless and electrical engineers and dealers. Their joint capital was £60, of which the debtor provided two-fifths. This business was not successful, and the partnership was dissolved in May 1928, after which the debtor continued on his own account, but had to discontinue after two months. He stated that he had removed £150 worth of stock to a store room, intending to return it to his creditors who supplied it, but it was sold by the high bailiff. The examination was adjourned for closing.

G. M. WILSHAW and G. SHARPE, trading as Wilshaw and Sharpe, 320, Padiham Road, Burnley, Lancs., electrical dealers.—The public examination herein was held on January 15th, at the County Court House, Burnley. Debtors' statement of affairs showed liabilities of £763 and a deficiency of £516. They attributed their failure to lack of capital, and experimental work in battery eliminators and loud speakers, which had not proved successful. They started business in April, 1925, with a capital of about £86. The business was fairly successful until March, 1928, but then the takings had fallen considerably. They stated they were aware of their position in July, 1928. The examination was adjourned.

H. J. BROWNHILL, back of 48, Whitehouse Street, formerly 34, Broadstone Avenue, Leamore, and 161, Bloxwich Road, Walsall, Staffs., electrical engineer.—The receiving order in this matter was made on the debtor's own petition. The first meeting of creditors was held recently at the Official Receiver's office, Wolverhampton, when the case, being a summary one, was left in the hands of the Official Receiver as trustee of the estate. The following are creditors:—

	£		£
Electrical Conduits, Ltd.	53	Walsall Hardware Mfg. Co., Ltd.	39
Jones, D.	35		

C. K. GOVETT (K. Govett & Co.), electrical contractor, 179, Albany Road, Cardiff.—First meeting, January 25th, at 34, Park Place, Cardiff; public examination, March 7th, at the Law Courts, Cardiff.

J. G. RITCHIE, electric lamp dealer, 54, Woodsley Road, Leeds.—First meeting, January 24th, at 24, Lower Bond Street, Leeds; public examination, February 5th, at the County Court House, Albion Place, Leeds.

S. S. KELLY, electrical contractor, 59, North Road, Durham.—Last day for receiving proofs for dividend, January 26th. Trustee, Mr. H. J. Armstrong, 2, Saville Place, Newcastle-upon-Tyne.

W. G. HOLMES, wireless and electrical engineer, 42, Walcot Street, Bath.—First and final dividend of 2s. 11½d. in the £, payable January 21st, at the Official Receiver's office, 26, Baldwin Street, Bristol.

N. H. WOOD, electrical engineer, 32, Highway Avenue, Thornton Heath.—First and final dividend of 1s. 10d. in the £, payable on January 25th, at the Official Receiver's office, 29, Russell Square, W.C.1.

S. STEIN & SONS, electricians, 36, Warwick Street, Glasgow.—Estates sequestrated by the Court of Sessions, January 16th. A meeting to elect a trustee and commissioners is to be held to-day (Friday) at the Faculty Rooms, St. George Place, Glasgow. Proofs of debts are to be submitted by May 16th. Agents, Messrs. D. & J. H. Campbell, 31, Moray Place, Edinburgh.

H. BUCKLEY, electrician, 23, Asylum Road, Old Kent Road, S.E.15.—Receiving order made January 15th on a creditor's petition. First meeting, January 28th; public examination, February 20th, both at Carey Street, W.C.2.

H. F. LAWRENCE, electrical engineer, 43, Canterbury Road, Margate.—Receiving order made January 16th on debtor's own petition.

E. D. JONES, electrical engineer, Royal Sportsman Hotel, Portmadoc, Carnarvon.—Last day for receipt of proofs for dividend, February 2nd. Trustee, Mr. I. D. Hooson, Official Receiver, St. Peter's Churchyard, The Cross, Chester.

W. A. HAMMOND, wireless dealer, 31, Middle Street South, Great Driffield, Yorks.—First and final dividend of 10s. 8d. in the £ payable January 25th at the Official Receiver's office, 37, Scale Lane, Hull.

Company Liquidations.

KEYSTONE INVESTMENT TRUST, LTD., Bank Chambers, Market Square, Kingston-on-Thames—The statutory first meetings of the creditors and shareholders of this company (in liquidation) were held on January 17th at Carey Street, W.C. Mr. J. Barwick Thompson reported that the company was registered in April, 1923, to carry on the business of an investment and trust company and all kinds of financial and commercial business. It was promoted by the late Wilfred Henry Butler, whose real name was stated to have been Walter Henry Brown, and who for some years had carried on the business of an outside broker in conjunction with another person at Kingston-on-Thames, under the style of Glover & Butler. So far as it had been possible for the Official Receiver to ascertain the fact, it appeared to be clear that the management of the affairs of the Trust were entirely under the control of Butler, and he regretted to say that owing to the death of that gentleman in October last (his body was recovered from the Thames) and the absence of written-up books since December, 1926, there was no prospect of any statement of affairs being received or reliable figures being prepared. According to the returns filed at Somerset House, 81,134 shares of £1 each had been issued for cash, and practically the whole of the Trust's capital had been utilised in financing a number of companies which were promoted by Butler. Among the number was the Pinnacle Switchgear Co., Ltd., which was promoted in April, 1925, with a nominal capital of £21,000 divided into 20,000 preference shares of £1 each and 20,000 ordinary shares of 1s. each, and was formed to carry on business for the manufacture of electric switches and fuses to be supplied principally to the Admiralty. It appeared that the company was a reconstruction of the Wholesale Electric Co., Ltd., which carried on business at Weybridge, and was stated to have been originally promoted by two undischarged bankrupts. The Trust acquired 250 shares of the Electric Co. in January, 1924, and subsequently took up debentures to the nominal value of £2,800. Part of these debentures were disposed of, and in July, 1925, the Trust was the registered holder of the 250 preference shares and debentures for £2,050. The Electric Co. went into voluntary liquidation and a reconstruction scheme was carried through under which the Trust was allotted 4,720 £1 preference shares and 19,993 deferred shares in the new company (Pinnacle Switchgear Co., Ltd.). Further shares were acquired by the Trust, some of which were subsequently sold. On December 31st, 1926, the books disclosed that the Trust held 3,110 preference and 19,283 deferred shares. Loans amounting to £3,060 were also made by the Trust, which loans were still unsatisfied. From information obtained by the Official Receiver, it appeared that the Switchgear Co. created debentures for £3,000 in March, 1927, and on August 15th following the debenture holder appointed a receiver, who carried on the business for a short time, and subsequently disposed of it for an amount insufficient to discharge the sum due under the debentures. The loss to the Trust in connection with the Switchgear Co. was £6,899.

Another company in which the Trust sunk £11,874 by way of loans and purchase of shares was the Tidal Power Syndicate, Ltd., which Butler registered in July, 1924, under the title of Weaver Tidal Power Syndicate, Ltd., the name being changed in November, 1925. The object of the syndicate was to acquire certain land at West Mersea, Essex, with a view of utilising the rise and fall of the tides for the production of power for electricity. It was the intention that the syndicate should promote a large public company in order to carry through the original scheme for the development of tidal power, but difficulties arose in connection with reports on the property and in August, 1927, the funds of the syndicate were exhausted and the mortgagees commenced proceedings for payment of a mortgage for £16,000 and interest. The syndicate was stated to be without funds or assets of any kind, and its operations had been suspended.

The chairman added that the books of accounts to the end of 1926 showed profits and dividends were paid in 1924, 1925, and 1926, absorbing £13,881. It was perfectly clear that none of the profits disclosed in the accounts were earned by the Trust, and that in each case the dividends were paid out of capital without any justification whatever.

Dealing with the present position, the chairman said that apart from a claim for £1,000 in respect of income tax, only a few debts of nominal amount had been notified to the Official Receiver, but he understood that various sums amounting to £9,000 had been advanced to the Trust in connection with the promotion of the Tidal Power Syndicate, and they might be liabilities of the Trust. There appeared to be no tangible assets, and as the whole of these financial ramifications had been controlled by the late Butler, it was utterly impossible in the absence of books and records since December, 1926, for anyone to attempt to unravel them. It was clear, however, that no return could be paid to either the creditors or the shareholders. The liquidation was left in the hands of the Official Receiver.

MULTIRAY WIRES & ALLOYS, LTD., 34, Ludgate Hill, London, E.C.—Under a winding up order made against this company on December 10th on a creditor's petition the statutory meetings of the creditors and of the shareholders were held on January 16th at Carey Street, W.C. A statement of affairs was submitted showing ranking liabilities of £1,103, net assets of £14, and a total deficiency of £3,089 with regard to the shareholders. It appeared that the company was registered on March 17th, 1927, with a nominal capital of £2,000 divided into shares of £1 each, its objects being to take over from Thomas Brown his formulæ for the manufacture of nickel chrome alloy billets to be drawn into wire for use in the construction of electrical fires and stoves, &c., and generally to carry on business as founders. Eric Pickard was the promoter of the company and he had stated that there was and still is a great commercial demand for a pure nickel chrome

alloy for use in electrical heaters. On March 23rd, 1927, an agreement was entered into between Brown and the company whereby for a consideration of £1,050 to be paid in shares of the company Brown sold to it his formulæ. As a result of an apparent misunderstanding the company was carrying on business with insufficient capital from the outset. Both during negotiations with a Swiss company for the acquisition by that company of the right to manufacture and sell the products of the alloy in Switzerland, France, and Italy, and to supply to the company such quantities as it had demand for in Great Britain, and also afterwards, the company carried on business in the manufacture, sale of castings, &c., in nickel chrome alloy and also experimented with a special product in stainless iron. It appeared to have obtained some extremely good orders but did not possess the capital to carry them out profitably. An overdraft was obtained from the bank on the guarantee of the directors, and one of their number advanced small sums from time to time to enable wages to be paid. According to the books of accounts sales had amounted to £6,473, resulting in a gross profit of £813 and a net loss of £1,019. Shortly before the petition to wind up was presented various judgment creditors levied execution on the company's effects, and on the seizure and sale of them by auction the company's business came to a standstill. The total assets were unlikely to prove enough to pay the costs and expenses of the liquidation and petition. The failure and insolvency of the company was attributed to the shortage of working capital occasioned by the failure of the projected arrangement with the Swiss company the fulfilment of which was calculated to provide the company with ample capital and be the source of considerable profit in the sale of the nickel chrome wire. The meetings resulted in the liquidation of the company remaining in the hands of the Official Receiver.

MOHAWK RADIO, LTD., wireless dealers, 252, Fratton Road, Portsmouth.—The statutory meeting of the creditors was held on January 15th, at 50, Gresham Street, E.C. Mr. A. A. Reeves, I.A., of Bradford, the liquidator, occupied the chair. The statement of affairs submitted showed ranking liabilities of £2,220. The net assets were £392, and there was a deficiency of £1,828. The estate showed approximately 3s. 6d. in the £. The liquidator stated that the principal cash creditor was Mr. T. O. Peet, who had advanced the company sums totalling £742, whilst Mrs. Peet had lent £300. The Mohawk Service and Fitting Station, Ltd., were also creditors for £356. The issued capital of the company was £800, all of which was fully paid. The business was commenced in December, 1926, as the Mohawk Radio Co. During the half-year to June, 1927, the turnover was £936, with a gross profit at the rate of 45 per cent., and there was a net profit of £106. The company was registered on December 10th, 1927, but it took over the business as from June of that year. During the year to June, 1928, the sales were £1,882, but the gross profit was only at the rate of 11 per cent., and, after allowing for all the expenses, there was a net loss of £973. Since June of last year the sales had only been £740, with a gross loss of £421, and a net loss of £1,270. In reply to a question, the chairman said that the gross loss during the last six months must have been brought about through the company being obliged to cut prices. A creditor asked what had happened to the business, and the liquidator replied that he had been hoping to sell it as a going concern. He was afraid, however, that that was not possible. He had, however, been continuing the business and realising the stock. No definite resolution was passed, but the opinion was expressed that the voluntary liquidation of the company should be continued, with Mr. Reeves as liquidator.

MUNICIPAL CONTRACTS, LTD.—A meeting of members is called for February 18th at 3, Warwick Court, Gray's Inn, W.C.1, to hear an account of the winding up from the liquidator, Mr. A. H. Partridge.

FLUORADS, LTD.—Meeting of creditors held January 21st. Particulars of claims to be sent to the liquidator, Mr. W. Elles-Hill, 41, Bedford Square, W.C.1, by January 30th.

IMPROVED APPLIANCES, LTD.—A general meeting of members is called for February 21st at 43, Fetter Lane, E.C.4, to hear an account of the winding up from the liquidator, Mr. H. R. Reid.

COUNTY ELECTRICAL & WIRELESS STORES, LTD.—A petition for the winding up of this company has been presented to the High Court, and will be heard by Mr. Justice Romer on January 28th.

Dissolutions of Partnership.

LANSING EQUIPMENT CO., electric truck manufacturers and agents, 96-98, Victoria Street, S.W.—Messrs. F. E. Bagnall and H. F. Anns have dissolved partnership. Mr. Bagnall will attend to debts and continue the business.

NELSON & FLEET, electrical engineers, 38, Fylde Street, Preston.—Messrs. J. H. Nelson and S. Fleet have dissolved partnership. Mr. Fleet will attend to debts and continue the business in his own name, while Mr. Nelson will commence business under his own name at 36, Ribble Bank Street, Preston.

Private Arrangements.

LAWFORD CARR HUTTON, trading as The Sports and Radio Stores, Queen's Parade, New Southgate, N.11.—This debtor executed a deed of assignment for the benefit of his creditors in September, 1926. Under this deed Mr. Charles Latham, of the Wireless and Radio Trades Guardian Association, Ltd., acted as trustee, and the business has since been carried on under his supervision, and is still being continued. Dividends have been distributed from time to time, and it is now stated that a final dividend of 5s. in the £ is being paid, making 20s. in all.

Receiver Appointed.

ATTAIX, LTD.—Mr. H. C. Merrett, 32, Finsbury Square, E.C.2, has been appointed receiver for the debenture holders, and the business is being offered for sale as a going concern to-day (Friday).

Trade Announcements.

The offices of the BRITISH PERLIT IRON CO., LTD., have been removed from London to 9, Rumford Street, Liverpool. Mr. J. A. Smeeton has resigned the managing directorship, but continues as a director. Mr. F. G. Martin, B.Sc., F.I.C., has been appointed technical manager.

On Tuesday last, Messrs. J. W. RUSSELL, LTD., electrical engineers and contractors, moved to new premises at 18, Queen's Road, Watford, where they have opened showrooms.

The WELSBACH LIGHT CO., LTD., states with regard to recent Press announcements relating to the sale of the freehold of its premises in Gray's Inn Road, that no move in the immediate future is contemplated.

Mr. W. C. SNOOK, trading as the Central Electric Service, has opened new premises at 42a, Portland Street, Brighton; he asks for price lists, &c., from radio manufacturers.

New Catalogues and Lists.

Messrs. DREW, CLARK & CO., whose showrooms are at 19, Ludgate Hill, E.C.4, have issued a reduced price list of extension ladders, &c.

MESSRS. LANDIS & GYR, LTD., North Acton, W.3.—Illustrated list describing their "Trivector" new kilovoltampere meter.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester.—Special Publication No. 7976/0-1, containing excellent illustrations and descriptive particulars of various electric locomotives that have been supplied by the company during the last year or two to the North-Eastern and Metropolitan railways at home, and to Indian, South African, Brazilian, and other railways overseas.

OMEGA LAMP WORKS, LTD., Rodney Place, London, S.W.19.—Price leaflet relating to "Omega" lamps.

BRITANNIA MANUFACTURING CO., LTD., Britannia Street, City Road, N.1.—Circular tabulating various pieces of electrical service work done by them for many classes of works and customers, and the money value of each contract.

MESSRS. NASH & HULL, LTD., 87, New Oxford Street, W.C.1.—Booklet describing the company's illuminated "Flexlume" and other signs, controllers, and so on. Illustrated.

VERITYS, LTD., Aston, Birmingham.—Stock list of "Verity Heemaf" high-torque motors, January, 1929.

VULCANISED FIBRE, LTD., Broadford Mills, Shalford, Guildford.—16-page booklet containing an illustrated description of the company's mills at Guildford, and tabular particulars of their "Castle" fibre for electrical and other purposes.

MESSRS. SMITH METERS, LTD., 186, Kennington Park Road, S.E.1.—Booklet describing the new Smith type A single-phase meter.

SIMMS MOTOR UNITS, LTD., Percy Buildings, Gresse Street, Rathbone Place, W.1.—Booklet describing Simms-Jurid link couplings. Illustrated.

ELECTRICAL APPLIANCES (BLACKPOOL), LTD., 5, Bloomfield Road, Blackpool.—An illustrated catalogue giving details and prices of switch-plugs, lampholders, &c.

MESSRS. J. H. TUCKER & CO., LTD., King's Road, Tyseley, Birmingham.—Folder A.4, containing illustrations and prices of the company's two- and three-pin plugs and sockets; and Folder S.8 describing, with illustrations, "Tucker" cooker control units.

THE STURTEVANT ENGINEERING CO., LTD., 147, Queen Victoria Street, E.C.4.—Catalogue 1,075, dealing in a very thorough manner with mechanical draught and cinder elimination. Illustrated.

Licence Refused.

The Public Control Committee of the London County Council decided last week not to renew the licence of the Russell-Hart Co., Ltd., to carry on an employment agency at Goschen Buildings, Henrietta Street, Strand, W.C. The company's application was opposed by the National Union of Commercial Travellers.

Spanish Import Duty Modifications.

The *Board of Trade Journal* for January 10th gives details of modifications in the Spanish Customs tariff which took effect on January 1st. The "second column" tariff is revised and re-established as the minimum tariff applicable to countries in treaty relations with Spain. Among the classes of goods affected are steam turbines, generating plant, motors, switchgear, fusegear, telegraph and telephone apparatus, electric locomotives, &c. In practically all of these cases the new minimum rate represents a reduction.

The Electrical Contractors' Dinner.

The annual dinner of the E.C.A. Allied Associations took place at the Savoy Hotel, London, on Tuesday evening last. Mr. W. H. Walton (president) took the chair, and the principal guests were Col. Wilfrid Ashley, M.P., Minister of Transport; Lt.-Col. K. Edgcumbe, president of the Institution of Electrical Engineers; Mr. T. P. Wilmshurst, M.B.E., Electricity Commissioner; and Mr. Frank Hodges, member of the Central Electricity Board. The company numbered nearly 300. A report of the speeches will appear in our next issue, but we may say now that Col. Ashley in his speech expressed the hope that a body with which he was personally acquainted would be able, in the near future, to select a rural area and offer electricity to the inhabintants on favourable terms for the purpose of discovering whether there was an earnest desire for electricity among the rural population of the country. Afterwards, in reply to our representative, he said that this should not be taken to mean that the Government would make a grant.

Employment during December.

The January *Ministry of Labour Gazette* states that employment in the engineering industry during December was slack on the whole, but showed an improvement in all districts and in nearly all sections. Conditions were good in the electrical engineering branch. As compared with December, 1927, employment showed a decline. The total number of unemployed in the engineering industry as a whole was 87,511, and the proportion was reduced from 9.6 to 8.9 per cent. In the electrical engineering branch there were 3,732 unemployed, the proportion falling from 5.2 to 4.7 per cent. The electrical wiring and contracting industry reported 991 unemployed, the proportion remaining at 6.4 per cent. There was an improvement in the electric cable, wire and lamp manufacturing group, the number of unemployed falling to 4,202 and the proportion from 5.2 to 4.9 per cent.

Calendar.

A bureau blotting book with artistic cover and calendar for 1929 has been issued by the BOSTON AND DISTRICT ELECTRIC SUPPLY CO., LTD.

Social Events.

The increasingly popular annual staff dinner of the Osram-G.E.C. Lamp & Glass Works and M.O. Valve Works, which was held on Friday last, as usual, at the Café Royal, Regent Street, was this year something in the nature of an experiment, both female and male members of the staff being present. The function seemed to be none the less successful for the mixing of the sexes. Mr. Chris. Wilson, director of the works, occupied the chair, and was supported by a number of directors of the General Electric Co., Ltd. Sir Hugo Hirst, chairman of the company, was prevented from attending for the second year in succession; on this occasion he was abroad with the Economic Mission in Australia. After the loyal toast, Mr. W. G. Woodward proposed "The G.E.C." Speaking of the good relations which existed between the employers and employés, he remarked that the company had paid £150,000 into the superannuation fund since its inauguration. The appointment of Sir Hugo Hirst to the Economic Mission was a compliment to the company and its staff generally. In reply, Mr. Max Railing, director of the company, briefly traced the development of the company since its inception in 1893. Commenting on present-day activities, he mentioned that among recent contracts obtained by the company were those for the Embankment lighting and for the telephone transmission from Cairo to Alexandria. Mr. F. P. Driver warmly welcomed the visitors, and Mr. W. H. Williams replied. Mr. D. Rusden proposed "The Chairman," and Mr. Wilson's reply concluded the first half of the programme. The rest of the evening was devoted to musical and other items by selected entertainers.

The third annual staff dinner and dance of the Enfield Cable Works, Ltd., was held on January 19th, at the Midland Grand Hotel, St. Pancras, the Earl of Verulam, chairman of the company, presiding. Mr. A. B. Collins, in proposing the toast of the "Enfield Cable Works, Ltd.," said that four or five years ago the company was referred to as the puppy of the industry, but this appellation had since been shorn of its implication. Thanks were due to the "skipper," Mr. Plutte, who more than anyone else had been responsible in guiding the company safely through many waters. He referred with regret to the death in the latter part of 1928 of Mr. Frank Richardson. In responding to the toast, the Earl of Verulam said the past year had been one of neither great success nor anxiety, but if 1929 bore out the promise of the opening month, the company would be faced with the problem of an excess of orders. This problem could be solved, however, with the co-operation of the staff, and such social functions were of great assistance in gaining this end. Mr. W. Fraser proposed the toast of "The Chairman," and was supported by Mr. F. Plutte. During the evening excellent musical items were rendered by Messrs. P. F. Deakin and E. C. Pentney, Mr. and Mrs. Collins, and the Berts Cabaret Dance Band; a successful function was concluded with dancing.

On the invitation of Mr. and Mrs. Robson, the employés of Messrs. Robson & Coleman, their wives and friends, were entertained to a whist drive, supper and dance at the Minories Assembly Rooms, Newcastle, on January 18th; about 100 were present. During the evening Mr. Turpin presented Mr. and Mrs. K. Smith with a timepiece and set of vases on the occasion of their marriage. Music was supplied by Mr. J. P. Anderson's Orchestra.

The first annual dinner of the Elliott Long-Service Association (Elliott Bros. (London), Ltd.), was held on January 11th, at the Green Man Hotel, Catford. Forty-one of the 48 members were present, illness being responsible for the absence of the others, including the president, Mr. W. O. Smith (chairman of the company). The vice-president, Mr. G. T. Cooper, was chairman for the evening. The toast of "Absent Members" was proposed by Mr. L. W. Smith (a director). Mr. J. Sandeman proposed the toast of "The Company," and Sir Keith Elphinstone, K.B.E., replied. The health of "The Chairman" was proposed by Mr. W. F. Beaden, and Mr. Cooper briefly responded. A musical programme was interspersed between the speeches.

On Friday, January 4th, the A.T.M. Male Voice Choir acted as hosts to a party of over 300 of the poorest children in the Fairfield district of Liverpool. The venue was the Strowger Works Canteen, which was gaily decorated for the occasion, and housed a giant Christmas tree. Here a substantial meal was served, followed by an entertainment. Before leaving, each little guest was handed a toy by Mrs. J. Nixon, wife of the works manager, and, as a parting gift, received three new pennies and a bag of fruit from the hosts.

Recent Contract.

The ENGLISH ELECTRIC CO., LTD., has received orders from the Bradford Corporation tramways for 11 complete single-deck four-wheel electric trolley omnibuses and six complete double-deck top covered six-wheel electric trolley omnibuses. The single-deck vehicles will each have a seating capacity for 34 passengers and will be equipped with a 60-h.p. motor, and the double-deck vehicles will each have a seating capacity for 56 passengers and will be equipped with two special 40-h.p. motors. Both types of vehicle will be equipped with "English Electric" standard foot-operated controller and rheostatic braking. The company has previously received orders for 16 electric trolley vehicles from the Bradford Corporation.

Canadian Preference Stipulations.

The Canadian Government has been receiving a series of vigorous representations from different British manufacturing interests about the probable effects of the recent Customs order which ordains that goods seeking the British preference should contain 50 per cent. of Empire labour and material. Manufacturers of the coarser cottons and firms which use copper as a raw material are complaining that the change will have the result of curtailing the preferential privileges, and are asking for a list of exemptions such as Australia allows. Firms which import half-finished goods from the European Continent and perform the final processes in Great Britain in order to get the advantage of the preference are also protesting. The Government has arrived at no decision.

Wages in the Engineering Industry.

The report of a special committee on wages policy is stated to be under consideration by the executives of the trade unions of the engineering industry. According to Mr. W. Sherwood, president of the Federation of Engineering and Shipbuilding Trades, after studying the report the unions will decide whether to put forward another claim for a national increase or concentrate upon obtaining higher wages in the more prosperous sections of the industry.

Unemployment.

There was a decrease of 68,130 in the number of registered unemployed during the week ended January 7th. At that date the total was 1,452,600, as compared with 1,520,730 on December 31st, 1928, and 1,232,070 on January 9th, 1928.

Australia and the Economic Mission's Report.

The Melbourne correspondent of *The Times* says that little discussion has so far been excited in Australia by the report of the British Economic Mission (summarised in our last issue, p. 121). It is thought that this may be due to the holidays. There has been some criticism of the report in Labour circles. Both agreement and disapproval have been expressed regarding the Commission's remarks upon compulsory arbitration.

Philips Lamps in Belgium.

The Belgian company La Lampe Belge proposes to increase the share capital from 2,000,000 fr. to 10,000,000 fr. by the issue of 8,000 shares of 1,000 fr.

German Cable Syndicate.

A meeting of representatives of cable manufacturers was held recently in Berlin for the purpose of attempting to revive the former syndicate for conductor wires. It was generally admitted that the present selling prices of insulated wires were below the costs of production, and that therefore measures were necessary for raising the level of prices, but the discussions failed to reach the desired result owing to the quota demands on the part of some makers.

An American Supply Company and Appliance Sales.

At a New York luncheon on January 9th, Mr. M. S. Sloan, president of the New York Edison Co., announced that his company was beginning a new policy of direct merchandising of electrical appliances instead of merely displaying and demonstrating appliances and receiving orders from manufacturers and dealers. He said that the company was entering the merchandising field honestly, honourably, and fairly; it would not cut prices or do anything else, directly or indirectly, to place any contractor or dealer under unfair competition. It would endeavour to stimulate that branch of its business by advertising, as it did other branches, and he believed that this would be beneficial to others who dealt in electrical appliances.

Incorporated Municipal Electrical Association.

An advertisement appears under our "Official Notices" today for a secretary (male) for the above Association to act under the instructions of the honorary secretary. The salary offered is £700 per annum.

Central Electricity Board Contracts.

The Central Electricity Board has placed contracts, amounting in all to approximately £400,000, for the construction of the 132,000-volt transformers for the area of the South-East England scheme, with Messrs. Ferranti, Ltd., Hollinwood, and the Fuller Electrical and Manufacturing Co., Ltd., Chancery Lane, London.

Prices of Materials.

The following prices are only general, and they may vary according to quantities and other circumstances:—

	CHEMICALS, &c.		Price Jan. 22	Fortnight's inc or dec.
a	Acid, Oxalic	per lb.	5½d.	...
a	Ammoniac, Sal	per ton.	£60	...
a	Ammonia, Muriate (large crystal)	,,	£52	...
a	Bisulphide of Carbon	,,	...	...
a	Borax	,,	£25	...
a	Copper Sulphate	,,	£25 10s.	...
a	Potash, Chlorate	per lb.	3½d. to 4d.	...
a	,, Perchlorate	,,	5½d.	...
a	Shellac	per cwt.	£13 10s.	...
a	Sulphur, Commercial	,,	£11	...
a	,, Roll	,,	£11	...
a	Soda, Chlorate	per lb.	3d.	...
a	,, Crystals	per ton.	£5 to £5 5s.	...
a	Sodium Bichromate, casks	per lb.	3½d.	½d. inc.
	METALS, &c.			
b	Aluminium, Ingots	per ton.	£95 to £100	...
b	,, Wire	per lb.	1/1 to 1/9	...
b	,, Sheet	,,	1/1 to 2/9	...
p	Babbitts Metal and Anti-friction Metal—			
	Grade I	per ton net.	£200	£2 dec.
	Grade II	,, ,,	£140	£1 dec.
	Grade III	,, ,,	£75	£1 dec.
c	Brass (rolled metal 2" to 12" basis)	per lb.	10¾d.	...
c	,, Tubes (solid drawn)	,,	1/0½ to 1/0½d.	½d. dec.
c	,, Wire, basis	,,	10¾d.	...
c	Copper Tubes (solid drawn)	,,	1/2½	½d. dec.
c	,, Bars (best selected)	per ton.	£102	...
c	,, Sheet	,,	£102	...
c	,, Rod	,,	£102	...
d	,, (Electrolytic) Bars	,,	£78 15s.	70/- inc.
d	,, ,, Sheets	,,	£143 10s.	...
d	,, ,, Wire Rods	,,	£88 15s.	70/- inc.
d	,, ,, H.C. Wire	per lb.	11s.	1/16d. inc.
f	Ebonite Rod	,,	2/8 to 2/6	...
f	,, Sheet	,,	2/8 to 2/6	...
g	German Silver Wire	,,	2/9	...
h	Gutta-percha, fine	,,	nom.	...
h	India-rubber, Para fine	,,	11½d.	½d. inc.
i	Iron Pig (Cleveland No. 3.)	per ton.	75/-	...
i	,, Wire, galv. No. 8, P.O. qual.	,,	£31	...
g	Lead, English pig	,,	£23 10s.	...
g	Mercury	per bot.	£22 2s. 6d. to £22 7s. 6d.	2/6 to 7/6 dec.
e	Mica (in original cases) small	per lb.	9d. to 2/-	...
e	,, ,, medium	,,	4/- to 8/-	...
e	,, ,, large	,,	10/- to 20/- & up	...
p	Phosphor Bronze, plane castings	,,	1/3½	...
p	,, ,, drawn bars & rods	,,	1/8½	...
p	,, ,, rolled strip & sheet	,,	1/8½	...
p	,, ,, wire	,,	1/4½	...
e	Platinum	per oz.	£14 5s.	£2 dec.
d	Silicium Bronze Wire	per lb.	1/-	½d. inc.
r	Steel, Magnet, in bars	,,	7½d.	...
n	Tin, Block (English)	per ton.	£222 to £222 10s.	£3 to £5 5s. dec.
n	,, Wire, Nos. 1 to 16	per lb.	3/11	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
W. F. Dennis & Co.

Reporting on the lead position on January 19th, Messrs. James Forster & Co. stated: "There is no fresh feature to report this week. Home demand has been a little better, the recovery in prices mid-week being probably due to this fact. Arrivals are fairly full. Conditions on the Continent remain quiet. No real revival in demand is in sight yet, and until that makes itself felt we must expect the market to remain in its present apathetic state."

Lighting and Power Notes.

Australia.—VICTORIA.—The ninth annual report of the Victorian State Electricity Commission covering the year ended June 30th last shows a total revenue of £1,511,471, as compared with £1,180,993 in the preceding year. Operating expenses were £756,214, interest £533,832, and depreciation £219,553, leaving a net profit of £1,872, as compared with a loss of £196,654 in 1926-27. According to the *Electrical Engineer of Australia and New Zealand*, this is the first year the Commission has been able to show a profit. The capital expenditure increased from £9,568,182 to £11,147,772. The electrical energy generated at Yallourn increased from 238,757,302 to 319,656,450 kWh, and the amount at Newport B station from 45,438,629 to 54,103,425 kWh. The sales of electricity increased from 245,752,546 to 319,282,728 kWh. Extensions are to be made to the briquette factory, and orders have been placed for additional plant, including four water-tube boilers and two 10,000-kW turbo-alternators. The total cost of the extensions is estimated at £725,000, and the new plant is to be in operation by the end of 1930. Extensions to be carried out at Yallourn include three 25,000-kW turbo-alternators and 12 additional boilers. During the year the Commission's hydro-electric scheme on the Rubicon River was put into operation. Preparations are being made to extend the supply into the north-western portion of the State, and the Commission proposes to take over the local undertakings in the cities of Ballarat and Bendigo when the franchises expire in 1931. A ring main is to be constructed from Melbourne through these cities. Already construction has been commenced on the first portion of this line, running to Castlemaine *via* Kyneton. Negotiations are in progress with a view to the Commission operating the electric tramway systems in these cities, and also at Geelong when it takes over the electricity supply.

Barnsley.—CHANGE-OVER.—At a recent meeting of the Corporation Electricity Committee, the borough electrical engineer reported upon a proposal for laying h.p. feeders in the borough in connection with completion of the change-over from d.c. to a.c., and the Committee decided to apply for sanction to a loan of £2,322 to cover the cost of the first portion of the scheme.

Birkenhead.—ELECTRICITY IN BULK.—The town clerk has reported to the Corporation Electricity Committee that the agreement for a bulk supply of electricity to the Hoylake and West Kirby Urban District Council has been approved by the Electricity Commissioners.

Bradford.—STREET LIGHTING.—The Corporation Street Lighting Committee has decided to establish electric street lighting at Tong, a district hitherto lighted by gas. The conversion involves the erection of 600 electric lamps.

Bury St. Edmunds.—ASSISTED WIRING SCHEME.—The Town Council has adopted an assisted wiring scheme, and a loan of £1,200 to cover the cost is to be applied for.

Canada.—ELECTRICAL DEVELOPMENT.—On November 28th, the Ontario Hydro-Electric Power Commission brought into operation the new 110,000-V transmission line linking up Smith Falls, Brockville, and other centres in eastern Ontario with the generating plants of the Gatineau Power Company on the Quebec side of the Ottawa River. Following upon the linking up of the Paugan Falls plant on the Gatineau River with the city of Toronto by the 220,000-V transmission line placed in commission on October 1st, the opening up of the new power line ranks as second in importance in the supply of hydro-electric energy for use in the Province of Ontario. The new line from the Farmers' Rapids plant on the Gatineau River crosses the Ottawa River at Remic Rapids, west of the city of Ottawa, where delivery is made to the Ontario Hydro-Electric Power Commission under a contract calling for the delivery of 60,000 h.p., in minimum annual increments of 6,000 h.p. over a period of ten years, and with an additional 40,000 h.p. in reserve.

Chesterfield.—LOAN.—The Corporation Electricity Committee has received sanction to the borrowing of £4,700 for the extension of the overhead equipment to New Whittington.

Clydebank.—ALL-ELECTRIC HOUSES.—The Town Council, at its last meeting, decided that the 346 houses to be erected by the Corporation on the Park Hall site shall be "all-electric."

Continental.—AUSTRIA.—A new hydro-electric power station has recently been completed at Pernegg by the Styrian Electric Supply Co. The plant comprises three vertical shaft Francis turbines and generators, each of 8,000 kVA capacity, generating electricity at 5,200 V at 150 r.p.m., and three transformers for stepping up the energy to 20,000 and 60,000 V.

Dalkeith.—SALE OF UNDERTAKING.—It is reported that the Town Council has agreed to the sale of its electricity undertaking to the Lothians Electric Power Co., Ltd. The company undertakes that the price of electricity in Dalkeith will be reduced to the same rates as those ruling in the adjacent area of the county, the alterations to be given effect to immediately the sale is completed. The undertaking was purchased by the Council from the Electric Supply Corporation, Ltd., about three years ago, at a cost of £18,000, and £12,000 has since been expended in changing over from d.c. to a.c., and in extensions of the system.

Eaglesham (Glasgow).—INAUGURATION OF SUPPLY.—A supply of electricity was switched on by Mr. Thomas Wallace, J.P., on January 11th. The streets are lighted by 26 lamps, and the system, with the exception of one street, employs overhead lines. The installation has been carried out under the superintendence of Mr. Johnstone, engineer to the Clyde Valley Electrical Power Co.

Guildford.—INQUIRY.—Colonel T. C. Ekin held an inquiry on January 15th respecting electricity schemes for the rural portions of West Sussex, Hampshire and Surrey. There were seven applications for Special Orders, three by the Aldershot Gas, Water and District Lighting Co., and others by the Power Development Co., Ltd., the Steyning Electric Light Co., Ltd., the Alton District Electricity Co., Ltd., and the Petersfield Electric Light & Power Co., Ltd. The Aldershot Co. stated that its proposed charges were 9d. per kWh for lighting, and 5d. per kWh for heating and power. There was opposition on the part of the Thakeham Rural Council, which suggested that the Aldershot scheme would not lead to the proper development of the area. The West Sussex County Council doubted whether the company could give supplies within the period; the Horsham Rural Council requested the Commissioners to carefully consider the merits of the competitive schemes; and the Billingshurst Council considered that the maximum prices were excessive, and that overhead lines would destroy the beauty of the countryside. The Godalming Gas, Light & Coke Co. also objected on the ground that it was not expedient for one gas company to compete with another, and that there was no demand for electricity in the parishes of Chiddingfold, Hambledon, and Witney, but it was pointed out that the Hambledon Urban District Council had asked for the extension of the mains to its district. Petersfield Rural District Council supported the Aldershot Company's scheme in preference to the Petersfield Electric Light Company's scheme. The inspector intimated that if mains were not laid in three years, the Ministry of Transport had power to revoke the Order.

Hastings.—LOANS.—The Town Council has applied for sanction to loans of £2,500 for services, £1,000 for mains and overhead lines, and £500 for transformers.

Leicester.—ELECTRICITY SUPPLY.—The Corporation Electricity Committee has made an agreement with Boots' Cash Chemists (Eastern), Ltd., for the supply of electricity for the lighting of 34 and 36, Gallowtree Gate, subject to a fixed annual charge of £600 per annum on a connected load not exceeding 50 kW, and an additional annual charge of £12 per kW for every kW over 50 connected, plus a charge of 1½d. per kWh for all electricity consumed.

London.—BERMONDSEY.—The Borough Council Electricity Committee has been asked by the L.C.C. to undertake the wiring of the new flats in connection with its housing scheme in Hankey Place. The Committee has agreed to do this on condition that the buildings do not include gas lighting.

ST. PANCRAS.—The Electricity and Public Lighting Committee has recommended that a bulk supply of electricity be given to the L. & M.S. Railway Co., at Euston Station, and that, providing the company accepts the terms, h.p. mains be laid at an estimated cost of £4,300. The proposed terms are £3 16s. per kW, and ¼d. per kWh up to 1,000,000 kWh, and beyond this ¼d. per kWh. The company's maximum demand would be 600 kW, representing a consumption of 1,576,800 kWh per annum for a period of seven years. The revenue from the company would be approximately £4,496 per annum.

Manchester.—PROGRESS DURING NOVEMBER.—During the month of November the Corporation electricity undertaking showed an increase in connections of 1,268 kW, bringing the total up to 367,663 kW; and the number of applications received for supply, including those for additional supplies, was 1,463, representing a total of 2,412 kWh. The number of hired cookers connected increased by 63, bringing the total actually on circuit to 4,947. Applications for the hire of cookers totalled 94. The maximum load recorded was 152,200 kW, but this was exceeded on December 11th, when the maximum load reached 155,940 kW. Two new sub-stations were put into commission at the works of the English Sewing Cotton Co., Ltd., and the L. & N.E. Railway Co., and additional plant was installed at six existing sub-stations.

Middleton.—SUPPLY TO HOUSING ESTATE.—The Town Council has had before it two schemes for giving a supply to the Mainways housing estate: (1) Laying a h.p. cable to a new sub-station, and l.p. distributors to the 70 new houses, the cost being £3,470; and (2) erecting overhead l.p. lines and the necessary distributors at a cost of £1,500. The Council has decided that although the first scheme will entail an annual loss it has more to commend it than the other. It has, therefore, been adopted.

Otley.—ELECTRICITY SUPPLY.—The Urban District Council is to change over the street lighting from gas to electricity, and has accepted a draft agreement submitted by the Electrical Distribution of Yorkshire, Ltd.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

ST. HELENS.—The advance on the pre-war charges for lighting and power reduced from 35 to 20 per cent.

BRIERFIELD.—Lighting: A reduction of ½d. per kWh.

FORMBY (LANCS.).—Lighting: From 7d. to 6½d. per kWh.

The Weald Electricity Supply Co., Ltd.—Lighting: From 11d. to 10½d. per kWh.

Richmond (Surrey).—CHANGE-OVER.—The Richmond (Surrey) Electric Light & Power Co., Ltd., has notified the Borough Council of its intention to alter the system of supply from d.c. to a.c.

Stockton-on-Tees.—LOAN SANCTIONED.—The Town Council has received sanction to a loan of £10,000 for prospective expenditure for mains and services.

Sittingbourne.—ELECTRICITY SCHEME.—The Kent Electric Power Co. has informed the Urban District Council that under its existing statutory powers it has decided to provide a supply of electricity for the town and Milton Regis. Steps are being taken to provide transmission lines, a sub-station, and other works, with a view to a supply being available before next winter.

Special Order.—Application has been made to the Electricity Commissioners by Messrs. P. W. Harries and T. J. Harries for consent to establish a generating station at Clyfon Mill, St. Clears, and to distribute electricity in the districts of St. Clears and Laugharne.

Torquay.—LOAN.—The Corporation Electricity Committee is applying for sanction to a further loan of £13,000 required during the next twelve months for the provision of mains and services throughout the area of supply.

PURCHASE OF UNDERTAKING.—The Committee has received a letter from the Teignmouth Electric Lighting Co., Ltd., intimating that it is prepared to sell the Buckfastleigh undertaking to the Corporation for the sum of £12,500. The Committee has decided that it cannot recommend the Council to make any offer which the company would be likely to accept, and it therefore recommends that the price be decided by arbitration and the town clerk has been authorised to engage an expert witness, and if need be counsel, to advise the Corporation in the matter.

Uttoxeter.—ELECTRICITY IN BULK.—The Urban District Council has arranged to obtain a bulk supply of electricity from the Burton-on-Trent Corporation electricity works.

Wigan.—FRINGE ORDERS.—The Rural District Council has given its consent to the application of the Corporation for three Fringe Orders to supply electricity to Wrightington Hall, the Grove Chemical Works, Appley Bridge, and to St. Joseph's College, Upholland, prior to obtaining Special Orders for Standish and Upholland. The Corporation will supply electricity for lighting at 5d. per kWh, as compared with 5½d. in the borough, and for heating at 1¼d. per kWh, as against 1d. per kWh. Power prices will be the same as in Wigan, but not subject to the same deductions.

Tramway and Railway Notes.

Aberdeen.—PROPOSED RAILWAY ELECTRIFICATION.—The question of the electrification of the Aberdeen suburban railways which has frequently been discussed has again been raised. It is pointed out that there are about 300 trains leaving the joint station daily.

Bradford.—RAILLESS CARS.—The Corporation is seeking powers to establish railless-car services on 40 routes, 10 of which will be outside the borough area.

Continental.—SWEDEN.—A *Reuter* message from Stockholm states that no fresh electrification programme will be carried out this year, but an inquiry is being made into the possible electrification of the Stockholm-Upsala, Hallsverg-Oerebro and Stockholm-Malmoe lines, all of which have considerable traffic. The electrification of the Stockholm-Gothenburg line has apparently had good results from the economic point of view, although a complete report on the first year of full traffic is not yet available.

New Light Railways.—According to *The Times*, the Southern Heights Light Railway, authorised by the Ministry of Transport confirmation of Order, dated December 29th, will be a single-track from the junction of the Southern Railway main line at Orpington to a point near the junction with the Croydon and Oxted branch of the Southern Railway near Sanderstead Station. The line will pass through the Kentish parishes of Farnborough, Keston, Downe, Cudham, and Westerham, and the Surrey parishes of Tatsfield, Titsey, Chelsham, and Warlingham. It will touch the highest points in Kent and Surrey, and the total length will be 15¼ miles. It is intended to electrify the new line. The opposition entered at the Ministry of Transport inquiry by the local authorities and landowners has been withdrawn or settled on agreed terms. There will be no level-crossings over public roads, but 23 bridges will be built. The length of the contract will be from 18 months to 21 months. The capital of the company will be £400,000 in ordinary shares and £250,000 in preference shares. The Southern Railway will work and maintain the line and will take 75 per cent. of the receipts. The engineer and promoter of the scheme is Colonel H. F. Stephens.

The Minister of Transport has recently made the Jarrow East End Light Railway Order, 1929, authorising the construction of a light railway in the borough of Jarrow in the County of Durham.

Telegraph and Telephone Notes.

Argentina.—WIRELESS TELEPHONY.—The International Telephone and Telegraph Corporation has made formal application to the Minister of Posts and Telegraphs for permission to establish a wireless-telephone service between Buenos Aires and New York.—*Reuter's Trade Service* (Buenos Aires).

Dutch East Indies.—WIRELESS TRAFFIC IN 1928.—The wireless-telegraph traffic between Holland and the Dutch East Indies (direct and *via* America) yielded during the fourth quarter of 1928, so far as the Dutch portion of the revenue is concerned, roughly 462,800 florins, compared with 328,000 florins during the corresponding period of the previous year; figures for the whole year 1928 were 1,663,950 florins, compared with 1,107,000 florins in 1927, being an increase of over half-a-million florins, or just over £40,000.—*Reuter* (Amsterdam).

France.—NIGHT TELEPHONE SERVICE.—Under new arrangements which lately came into operation, all telephone exchanges throughout France with more than 200 subscribers are now provided with both night and day services. No fewer than 170 exchanges are affected by the new order, bringing the total provided with a 24-hour service up to over 300 exchanges.

International Telephony.—POLAND.—A direct telephone service between London and Warsaw is about to be established.

Jugo-Slavia.—TELEPHONY AND TELEGRAPHY.—It is reported from Vienna that the Belgrade Government intends to lease all the telephone and telegraph services to private companies.

Railway Communication.—WIRED-WIRELESS.—In a review of the progress of the Great Western Railway during last year it is mentioned that a system of wired-wireless has been adopted, giving an additional channel of communication between Reading and Swindon. Transmission from Reading is on a wave-length of 6,000 metres, and from Swindon of 7,000 metres.

South Africa.—RADIO-TELEPHONY.—The South African Wireless Telegraph Co. decided on January 8th to order equipment for a radio-telephone service with England, which is expected to be in operation within nine months.

According to the *Daily Mail*, the British Post Office is awaiting the end of negotiations in the respective Dominions before beginning tests between England and Australia, South Africa and India; for these services a new receiving station is to be built this year at Baldock, near Hitchin.

Sweden.—TELEPHONE PATENTS.—A patent case of international importance, between the L. M. Ericsson Telephone Co., of Stockholm, and the Automatic Electric Co., of Chicago, U.S.A., has been decided by the magistrates' court of Stockholm. The Chicago Automatic Co. in 1924 sued the Swedish concern for infringement of a patent for a coupling device with automatic line-selection, used when a subscriber is connected with the central exchange by several lines, but has only one call number. The investigation now made of the patent showed that it is not valid, owing to the fact that such automatic arrangements were previously known through descriptions published in technical publications in England and America. The court found that for this reason the patent in question is void, and should not have been granted by the Swedish patent office, and the American concern was ordered to defray the costs of the Swedish company to the extent of 9,000 kronor. In addition to the annulment of the patent, effected through a countersuit brought by the Swedish company against the American one, the L. M. Ericsson Co. proved that even if the patent had been declared valid there would have been no infringement, as it had not been used by the Swedish company, which has branches, affiliated companies, agencies, and factories in 18 different countries.

The "Telfograph."—A TELEPHONE RECORDER.—Great possibilities are claimed for an invention that has been patented under the title of "an improved transmitter and remote recording system and apparatus therefor." Simple in the extreme, it consists solely of a small instrument, a few inches square, which acts either as a transmitter or a receiver of written messages, the connectin medium being either a telephone wire or wireless circuit. Its cheapness (the inventor, Mr. Archibald E. Telford, and the owner of the patent rights, Mr. W. J. Bullimore, stated to the *Morning Post*) supports the claim that it could be used by every telephone subscriber for receiving and transmitting written messages. The instrument contains a small typewriter of one key only, and a revolving drum on which the letters of the alphabet are arranged in suitable formation; a person can tap out the required letters, which are typed on tape automatically at either end of the telephone line. Should the engaged signal be given, the operation can still take place, and a message collected later by people when they return home.

Radio Notes.

Dutch East Indies.—NEW BROADCASTING CO.—The commercial agent at Batavia (Mr. H. A. N. Bluett) has informed H.M. Department of Overseas Trade of a report that the Nederlandsch-Indische Radio-Omroep Mattschappij (Netherlands Indian Broadcasting Co.) will shortly be formed. The company will be established in Holland, and will be represented locally by two delegates. The capital required is f. 600,000, of which f. 300,000 has been promised by Messrs. Maintz & Co., Radio-Holland, and the Philips group in equal shares. The broadcasting station will be built in the neighbourhood of Batavia; it is estimated that it will cost f. 400,000.

Germany.—LICENCES.—The number of subscribers increased during the final quarter of 1928 by 301,314, bringing the total to 2,635,567 on January 1st, 1929. The increase during 1928 was 625,725. Bavaria, in spite of its four transmitters, perhaps owing to the scattered peasant population, has not been able to boast of any great number of listeners, having only about six million inhabitants. According to *World-Radio*, they total now exactly 174,102, against slightly over 151,000 on October 1st. Every listener canvassing a new listener and giving his name and address to a Bavarian radio paper obtains a premium of 2 marks, the cost of a month's licence in Germany (24s. a year). The simultaneous transmitter at Berlin-East, which uses the same wavelength as Stettin and Magdeburg, has begun experimental transmissions.

Jamaica.—BROADCASTING.—Mr. Russell F. Pike, of the Radio Corporation of America, intends to form a wireless broadcasting corporation to be controlled and operated by Jamaica and also that the capital shall be raised on the island. He has received assurances of support from 12,000 Jamaicans of good standing.—*Reuter's* (Kingston).

Russia.—LICENCES.—The number of individual listening licences in the Soviet Union now exceeds 304,000, says *World-Radio*, of which roughly 264,000 represent dwellers in towns, the remaining 40,000 being villagers; the number of crystal-set users is 255,000, and the balance (49,000) have valve sets, and, of the latter, 13,000 have loud-speakers. Thus, 87 per cent. of the receiving sets are in towns and 13 per cent. in the country; 10,000 crystal sets and 300 loud-speaker sets are being used in "houses of detention" (the Soviet substitute for prisons). A Russian expedition has established a radio transmitting and receiving station on the Caucasian mountain Kazbek. Experiments are being carried out at various altitudes up to 5,300 metres. The leader of the expedition is the director of the most northerly station, Tiflis. The Chief Hydrographical Department of the U.S.S.R. has decided to establish a radio station on Cape Jelanyi, 77 degrees of northern latitude, to observe the movement of ice fields and also carry out scientific meteorological observations. It will be the most remote northern station in the world, and, together with those on Matochkin Shar and Yougorsky Shar, will serve the Polar seas.

Siam.—BAN EXPLANATION.—The Prince of Kambaeng Bejra, Minister of Commerce and Communications, explains that the law banning wireless apparatus is designed to protect the pocket of the Siamese citizen. Experiments are under way which are designed to test broadcasting conditions in Siam to find out what type of apparatus is most suited to the climate, the *Evening News* announces. As soon as they are completed, says the Minister, announcement will be made of the type of broadcasting contemplated for Siam and the type of wireless sets most suitable to receive it. Then the ban will be lifted.

Thermionic Valve Impedance.

A paper read before a recent meeting of the Physical Society of London by Mr. L. Hartshorn, A.R.C.S., B.Sc., D.I.C., of the National Physical Laboratory, described the application of the Wheatstone bridge to the measurement of the anode circuit admittance (or impedance) and the mutual conductance of a valve under actual operating conditions. Current of telephonic frequency is used, and the measurements can be made for grid bias of any desired value, while both methods can be made direct-reading. The results of measurements with a few typical valves show that although both anode circuit resistance and mutual conductance vary very considerably with the grid bias, the product of the two, which gives the voltage factor of the valve, is approximately constant. The anode circuit admittance consists of conductance associated with comparatively small capacity, but the latter is larger than the inter-electrode capacities of the valve when the filament is cold. The increase in the effective values of the inter-electrode capacities is explained by the presence of the space charge, which also has the effects of making these capacities vary with the frequency and of giving them a comparatively high power factor, especially at low frequencies.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—MELBOURNE.—February 26th. Posts and Telegraphs Department. Induction coils and registers for telephone work. (B.X. 5031.)*

March 18th. State Electricity Commission of Victoria. Insulators and accessories. (B.X. 4997.)*

Aylesbury.—Electricity Department. 11,000-V switchgear. (January 18th.)

Basingstoke.—January 29th. Electricity Department. One heavy oil engine with a 800-kW, 3-phase, 50-cycle alternator. (January 18th.)

Batley.—February 4th. Electricity Department. L.p. cable. (See this issue.)

Belfast.—January 29th. Public Health Committee. Installation of automatic telephones in the Infectious Diseases Hospital, Purdysburn. (January 11th.)

Belgium.—GHENT.—February 11th. Municipal Council. 16 electric portal cranes. (A.X. 7398.)*

Carlisle.—Electricity Department. One 15,000-kW turbo-alternator and condensing plant. (See this issue.)

Cheadle and Gatley.—February 1st. Electricity Department. H.p. overhead line and outdoor type transformer. Specification from Mr. R. W. Willis, electrical engineer, 37, High Street, Cheadle.

Croydon.—February 7th. Electricity Department. 14,000 tons of coal suitable for use on chain-grate mechanical stokers. (See this issue.)

Denny and Dunipace.—Town Council. Electrical work in connection with the Council's housing scheme. Particulars from Messrs. J. Strong & Wilson, architects, Falkirk.

Dublin.—January 30th. Controller of Stores, Department of Posts and Telegraphs. 6,000 stay rods, fitted with ratchet nuts and washers. (See this issue.)

Egypt.—CAIRO.—March 27th. Ministry of Interior. Supply and installation of an electric lighting system for the town of Fashu. (B.X. 5037.)*

Glasgow.—January 28th. Corporation. Electrical and heating installation at additional police headquarters. Specifications, &c., from Public Works office, 64, Cochrane Street (deposit £3 3s.). Offers to town clerk.

Grimsby.—February 6th. Electricity Department. H.p. steam pipes and valves, circulating-water pipes and valves, water-service pipes and valves. (See this issue.)

Halifax.—February 4th. Town Council. Electrician's work required in erection of 64 houses, Moor Road. Specifications, &c. (deposit £2 2s. each) from Mr. A. C. Tipple, borough engineer, Crossley Street.

India.—February 5th. Turbo-alternator set, condenser, boiler, economiser, switchgear and cables for the new power station, Delhi. (B.X. 4944.)*

London.—CENTRAL ELECTRICITY BOARD.—February 15th. 66,000-V cables (London area) in connection with the South-East England Electricity Scheme. (January 11th.)

February 18th. Supply, delivery and erection of 132,000-V overhead transmission lines in connection with the Central England and North-West England and North Wales Electricity Schemes. (January 4th.)

February 22nd. 132-kV outdoor switchgear for the transforming stations in the Central England Electricity Scheme area, 132,000-V transformers. (January 11th.)

March 4th. Supply, delivery and erection of 66,000-V switchgear for the South-East England Electricity Scheme, 1927 (London Area), and the supply, delivery and erection of 132,000-V transformers, and 132,000-V outdoor switchgear for the North-West England and North Wales Electricity Scheme. (January 18th.)

LONDON COUNTY COUNCIL.—February 4th. Wiring and fittings for electric lighting, heating and cooking in 86 tenements on Ossulston Estate. H.p. and l.p. cables, core re-actors, control battery, &c., for Greenwich power station. (January 18th.)

February 7th. Wiring and fittings for electric lighting at the Coroner's Court, Bethnal Green, and the Weights and Measures Office and Coroner's Court, Clapham (about 80 wiring points). (See this issue.)

Leeds.—February 4th. University. Electric wiring, &c., of the mining section of the University. (See this issue.)

February 15th. Electricity Department. Annual contracts for stores. (See this issue.)

Liverpool.—January 31st. Electricity Department. Approximately 190,000 tons best quality 1¼-in. or 1½-in. steam slack, suitable for use on chain grate stokers; also 60,000 tons fine slack, suitable for pulverising, required during year ending March 31st, 1930. Specification from city electrical engineer, 24, Hatton Garden, Liverpool.

Lough Derg, Pettigo (Co. Donegal).—February 14th. Supply, delivery, and erection of two 10-kW heavy oil engine generating sets, storage battery, and switchboard. (January 18th.)

Newmilns (Ayrshire). — February 9th. Town Council. Electrical wiring in connection with the Council's housing scheme. Specifications from the burgh surveyor.

New Zealand.—WELLINGTON.—March 12th. Posts and Telegraph Department. Switchboard cords. (B.X. 5017.)*

April 9th. Public Works Department. Induction voltage regulators for Lake Coleridge scheme. (B.X. 5018.)*

Otley.—February 1st. Urban District Council. Electrician's work required in erection of 40 houses, Westbourne estate. Specifications (deposit £1 1s. each) from Mr. C. F. Hodgson, surveyor to Urban District Council.

Portsmouth.—February 6th. Tramways Committee. Insulating materials, lamps, motor windings, overhead line materials, &c. (January 18th.)

Sheffield.—February 14th. Electricity Supply Department. Turbo-alternator, condensing plant, evaporating and steam preheating plant, water-tube boilers, chimneys, superheaters, stokers, or pulverised fuel firing equipment, economisers, &c., wagon tippers, conveyors and elevators, cooling towers, electrically and hand-operated travelling cranes. (January 11th.)

South Africa. — JOHANNESBURG. — February 14th. Town Council. Two 1,080-kVA transformers. (B.X. 5005.)*

CAPE TOWN.—March 15th. City Council. Metal-clad switchgear. (B.X. 5004.)*

Staines.—February 9th. Board of Guardians. An additional 168 lighting points, including cables, at the Institution, London Road, Ashford, Middlesex. Specifications from Mr. J. H. Tyars, architect, 28, Victoria Street, Westminster, London, S.W.1.

Wandsworth.—February 2nd. Board of Guardians. Reorganisation of the engineering plant at the Tooting Hospital. (See this issue.)

West Ham.—February 18th. Education Committee. Installation of electric lighting at South Hallsville new school, Agate Street, Tidal Basin. (See this issue.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Australia.—MELBOURNE.—The *Exchange Telegraph* reports that the British General Electric Co., Ltd., has received the contract for the installation in Sydney and Melbourne of apparatus for the telegraphic transmission of pictures.

Barnes.—Urban District Council. Accepted :—
Supply and maintenance of departmental telephones at the Council House.—Reliance Telephone Co., Ltd.

Bedford.—Electricity Committee. Recommended :—
Two Lea coal meters (£75).—Lea Recorder Co., Ltd.
Electroflo temperature outfit (£90).—Electroflo Meters, Ltd.

Brighton.—Lighting Committee. Accepted :—
New battery at North Road sub-station.—Tudor Accumulator Co., Ltd. (£6,812).
Two 200-kVA transformers (£277).—Ferranti, Ltd.

Dublin.—G.P.O.
Electric lamps.—Edison Swan Electric Co., Ltd.

Edinburgh.—Education Committee. Accepted :—
Installation of electric light at the Leith Academy secondary school (£3,952).—Robert Edgar & Co.

Government Contracts.—The following Government contracts were placed during December, 1928 :—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.

Battery.—D.P. Battery Co., Ltd.
Cable.—Anchor Cable Co., Ltd.; British Insulated Cables, Ltd.; Edison Swan Cables, Ltd.; Enfield Cable Works, Ltd.; Pirelli-General Cable Works, Ltd.; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; India Rubber, Gutta Percha

and Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Siemens Bros. & Co., Ltd.; St. Helens Cable and Rubber Co., Ltd.
Electrically-driven h.p. air compressors.—G. & J. Weir, Ltd.; P. Brotherhood, Ltd.
Electric jib cranes.—Wharton Crane and Hoist Co., Ltd.; Sir Wm. Arrol & Co., Ltd.
Motor-generators.—Newton Bros. (Derby), Ltd.
Electric lamps.—General Electric Co., Ltd.
Switches, cubicles, &c.—Johnson & Phillips, Ltd.
Electric travellers.—Sir W. Arrol & Co., Ltd.; J. Adamson & Co.
W./t. valves.—Mullard Radio Valve Co., Ltd.

WAR OFFICE.

Electric lamps.—General Electric Co., Ltd.
Cable.—Johnson & Phillips, Ltd.; W. T. Glover & Co., Ltd.
Inert cells.—Siemens Bros. & Co., Ltd.

AIR MINISTRY.

Internal wiring (Boscombe Down).—Cox, Walkers and Partners.
Dynamometers.—Electric Construction Co., Ltd.
Fans.—James Keith & Blackman Co., Ltd.
W./t. valves.—A. C. Cossor, Ltd.; Edison Swan Electric Co., Ltd.

POST OFFICE.

Telephone apparatus.—Automatic Telephone Mfg. Co., Ltd.; Ericsson Telephones, Ltd.; General Electric Co., Ltd.; Phœnix Telephone and Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; Standard Telephones and Cables, Ltd.; Telephone Mfg. Co., Ltd.
Cable.—British Insulated Cables, Ltd.; Callender's Cable and Construction Co., Ltd.; Connollys (Blackley), Ltd.; Enfield Cable Works, Ltd.; W. T. Glover and Co., Ltd.; Hackbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Standard Telephones and Cables, Ltd.; Union Cable Co., Ltd.
Loading coils.—General Electric Co., Ltd.; Siemens Bros. and Co., Ltd.
Conduit.—General Electric Co., Ltd.; Walsall Hardware Mfg. Co., Ltd.
Telephone cords.—Reliance Electrical Wire Co., Ltd.
Ducts.—Albion Clay Co., Ltd.; Oates & Green, Ltd.; Standard Brick and Terra Cotta Co., Ltd.
Electric lighting fittings.—Engineering and Lighting Equipment Co., Ltd.; Revo Electric Co., Ltd.
Insulators.—Bullers, Ltd.; Doulton & Co., Ltd.; Taylor, Tunnicliff & Co., Ltd.
Electric lamps.—Edison Swan Electric Co., Ltd.
Motor-generators.—Electro Dynamic Construction Co., Ltd.
Flameproof wire.—Macintosh Cable Co., Ltd.
Manufacture, supply, drawing-in and jointing cable.—Preston-Blackpool No. 2: British Insulated Cables, Ltd.
Electric lighting and power wiring Manchester Central Telephone Exchange.—W. J. Furse & Co. (Manchester), Ltd.
Alterations to power plant and switchgear, Liverpool head P.O.—Metropolitan-Vickers Electrical Co., Ltd.
Short-wave radio-telephony transmitter No. 3 (Rugby radio station).—Standard Telephones and Cables, Ltd.
Telephone exchange equipment.—Pollards (S.W.), Valentine (Ilford), Egham: Automatic Telephone Mfg. Co., Ltd. Maidstone: Standard Telephones and Cables, Ltd. Sub-contractors: Electric Construction Co., Ltd., for charging machines; Crompton Parkinson, Ltd., for ringing machines; Chloride Electrical Storage Co., Ltd., for batteries. Aylesford, Barming, Bearstead, Boughton Monchelsea, Hunton, Otham, Wateringbury: Standard Telephones and Cables, Ltd. Sub-contractors: W. Jones & Co., for ringing machines. Bourne End: Standard Telephones and Cables, Ltd.; Clarke, Chapman & Co., Ltd. (Gateshead-on-Tyne). Cardiff Corporation: Relay Automatic Telephone Co., Ltd. Morningside, Murrayfield, Newington, Edinburgh (Central), Swansea, Hitchin: Siemens Bros. & Co., Ltd. Herne Bay: Ericsson Telephones, Ltd. Sub-contractors: Crompton Parkinson, Ltd., for motor generator; Newton Bros. (Derby), Ltd., for ringing machines; Chloride Electrical Storage Co., Ltd., for batteries. Fairfield (Croydon): General Electric Co., Ltd. Sub-contractors: Crompton Parkinson & Co., Ltd., for machines; D.P. Battery Co., Ltd., for batteries.
Telephone repeater station equipment.—Glasgow, Liverpool and Manchester: Standard Telephones and Cables, Ltd. Portsmouth and Tavistock: General Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Battery materials.—India Rubber, Gutta Percha and Telegraph Works Co., Ltd.; Siemens Bros. & Co., Ltd.
Cables.—British Insulated Cables, Ltd.; Hooper's Telegraph and India Rubber Works, Ltd.
Electric fans.—General Electric Co., Ltd.; Metro-Vick Supplies, Ltd.
Overhead-line materials.—Bullers, Ltd.
Radium and containers.—Watson & Sons (Electro-Medical), Ltd.;
Static transformers.—Bruce Peebles & Co., Ltd.
Telephone switchboards.—Ericsson Telephones, Ltd.
Train-lighting spares.—J. Stone & Co., Ltd.
Transformer kiosks.—English Electric Co., Ltd.
Wireless-telephone scheme.—Marconi's Wireless Telegraph Co., Ltd.

H.M. OFFICE OF WORKS.

Electrical engineering labour.—Birmingham: Harrison and Searle, Ltd. Bristol: R. Whipp & Co. Liverpool: F. Martin.
Cable.—National Physical Laboratory: Power Contracts, Ltd.

Kettering.—Electricity Department. Accepted:—
Cables (£1,194).—Union Cable Co., Ltd.
Transformers.—?50 kVA (£185), Crompton Parkinson, Ltd.; 250 kVA (£170), Brush Electrical Engineering Co., Ltd.; 50 kVA (£51), Ferranti, Ltd.

London.—L.C.C. EDUCATION COMMITTEE.—Accepted:—
Electrical work at School of Arts and Crafts (cost, plus 15 per cent. on labour and 10 per cent. on materials).—H. J. Cash & Co., Ltd.
LONDON COUNTY COUNCIL.
Feeder panel switches.—Edison Swan Electric Co., Ltd.
ISLINGTON.—Electricity Committee. Recommended:—
Rental and hire-purchase wiring installations.—M. J. T. Thomas & Co.
KEMPTON PARK.—Metropolitan Water Board. Recommended:—
Two sets of centrifugal pumps, one water turbine driven and one electrically driven, at pumping station (£542).—Worthington-Simpson, Ltd.
CENTRAL ELECTRICITY BOARD.—Accepted:—
130,000-V transformers in connection with the South-East England Scheme (value approximately £400 000).—Ferranti, Ltd., and Fuller Electrical & Manufacturing Co., Ltd.

Manchester.—Electricity Department. Accepted:—
6,600-V feeder from West Didsbury to Charlton.—Callender's Cable & Construction Co., Ltd.
Three-inch weldless-steel tubes.—Stewarts & Lloyds, Ltd.

Southend-on-Sea.—Town Council. Accepted:—
Tramway points and crossings (£1,098).—Edgar Allen, Ltd.
Two sets of crossings for the pier tramway (£990).—Titan Trackwork Co., Ltd.
Two six-wheel double-deck top-covered trackless trolley vehicles, with pneumatic tires (£2,000 each).—Richard Garrett & Sons, Ltd.

Stockton-on-Tees.—Electricity Department. Accepted:—
Twelve months' supply of l.p. paper-insulated cable.—W. T. Glover & Co., Ltd.

Torquay.—Electricity Committee. Accepted:—
Overhead 11,000-V, 3-phase transmission line from Ipplepen to Dartington (£2,881).—Johnson & Phillips, Ltd.
Vertical shrouded ironclad switchgear for sub-station at Vicary Mills (£815).—Switchgear & Cowans, Ltd.

Wantage.—Rural District Council. Accepted:—
Installation of electric light and central heating at the old Cottage Hospital (£237).—Callas, Son, & May.

Whitby.—Urban District Council. Accepted:—
Electric lift on the Westcliff (£1,417).—William Wadsworth & Sons, Ltd.

Forthcoming Events.

Birmingham Electric Club.—Friday, January 25th. Grand Hotel, Birmingham. 7 p.m. Presidential address.

Association of Mining Electrical Engineers.—Saturday, January 26th. Joint visit to West of Scotland Branch, Glasgow. Discussion. "H.T. *v.* L.T. 'Underground.'"

Institution of Electrical Engineers.—Informal meeting. Monday, January 28th. Institution, London, W.C. 7 p.m. Discussion on "Mains Testing."

(Meter and Instrument Section).—Friday, February 1st. Institution, W.C. 7 p.m. "Recent Developments in Electricity Meters, with particular reference to those for special purposes." Mr. J. L. Carr.

(Irish Centre, Dublin).—Friday, January 25th. Gaiety Theatre, Dublin. 4 p.m. Faraday Lecture on "How Electricity Does Things." Mr. H. B. Atkinson.

(North-Eastern Centre).—Monday, January 28th. 7 p.m. "Recent Developments in Electricity Meters, with particular reference to those for special purposes." Mr. J. L. Carr.

(North-Midland Centre).—Tuesday, January 29th. Hotel Metropole, Leeds. 7 p.m. "The Construction of the Grid Transmission System in Great Britain." Messrs. Johnstone Wright and C. W. Marshall.

(Western Centre).—Monday, January 28th. Bristol. Faraday lecture on "How Electricity Does Things." Mr. Ll. B. Atkinson.

(Tees-side Sub-Centre).—Tuesday, January 29th. Grand Hotel, Middlesbrough. Annual dinner.

(North-Western Students' Section).—Tuesday, January 29th. Engineers' Club, Manchester. 7.15 p.m. "Electric Locomotives." Mr. D. J. Watkins.

(Scottish Centre).—Tuesday, January 29th. Informal meeting at North British Station Hotel, Edinburgh. 7 p.m. "Recent Extensions to Portobello Power Station." Mr. E. Seddon.

Institution of Engineering Inspection.—Tuesday, January 29th. Royal Society of Arts, John Street, Adelphi, W.C. 5.30 p.m. "Errors in Testing Bulk Supply by Random Selection." Mr. B. P. Dudding.

Royal Society of Arts.—Wednesday, January 30th. John Street, Adelphi, W.C.2. 8 p.m. "The Shannon Scheme and its Economic Consequences." Mr. G. Fletcher.

Institution of Mechanical Engineers.—Thursday, January 31st. Manchester. "Modern Development in Steam-Turbine Practice." H. L. Guy.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

Violet-ray apparatus marked "Shelton Laboratories."

S-AN-S wash boiler.

Notes.

The Holborn Explosion.

The Government inquiry into the Holborn explosion of December last was resumed on January 21st, when evidence was given as to the nature of the electricity supply cables in the area, and some interesting views as to the advantages or otherwise of laying high-pressure cables in subways, especially in close proximity to gas mains, were expressed. Major H. Richardson, managing director of the Metropolitan Electric Supply Co., said his company had a 10,000-V main running through High Street, Bloomsbury, and after the explosion this was found to have sagged from 1 ft. to 3 ft. in various parts. Notwithstanding this, the cables continued to function perfectly from the electrical point of view, and the supply was not interrupted in any way. At the same time, there had probably been some mechanical damage to the cables in parts, although it had not yet been possible to ascertain this, as the whole of the cable had not yet been uncovered for inspection purposes. The company had 28 street boxes in the area, each about 2 ft. cube, with solid air-tight covers. These carried low-pressure cables, and were opened up once a week for inspection and ventilation. He preferred the type of box used, with a regular system of inspection, and complete ventilation for a while. For the larger transformer chambers there were suitable means of ventilation of a permanent character. He found it difficult to say whether the gas which accumulated in such boxes was coal gas or not, although, when pressed by the Attorney-General, for the Post Office, he agreed it was possible for a mixture of coal gas and air to accumulate and possibly become ignited. Mr. Miller, K.C., for the gas company, referred to the Electricity Commissioners' Regulations with regard to street boxes, which stated that precautions must be taken to prevent the accumulation of gas in them, and Major Richardson replied that the regulations did not speak of ventilation so far as the small boxes were concerned, and he claimed that the company's system of inspection afforded sufficient ventilation and means for detecting any accumulation of gas.

Answering the Chairman, Major Richardson said he did not agree with laying high-pressure cables in subways close to gas mains. The possibilities in the event of a leak of gas and sparks from one of the cables were terrible to contemplate, and there was also the inevitable interference by one authority with the mains of another.

Dr. S. L. Pearce, chief engineer of the London Electric Power Co., said his company had h.p. mains in the area of the explosion, but the conditions of supply were not interfered with in any way, although the supply was cut off deliberately by request. At the same time, he expressed the same views as Major Richardson as to the possibility of mechanical damage which had not yet shown itself. Similarly, he confirmed the view that high-pressure mains should not be laid in subways, but direct in the ground at a depth of from 6 ft. to 8 ft.

Mr. W. B. Thorpe, chief engineer to the Charing Cross Electricity Supply Co., said his company had some low-pressure distributing mains in the district, but with a minor exception, they were armoured and lead sheathed or concentric and laid solid in earthenware ducts. As with previous witnesses, he said that the explosion did not affect the supply in any way, but a considerable number of street boxes of the non-ventilated type were damaged. Answering the Attorney-General, Mr. Thorpe said there had been one explosion in one of his street boxes due to coal gas, which was ignited by a workman using a blow-lamp. The fact that the old bitumen mains had been done away with had prevented the explosions that used to take place in street boxes, due to the gas caused by the distillation of the bitumen, and there had been no serious troubles from this cause in recent years. He did not agree that the use of open gratings for the ventilation of street boxes would be practicable, as they would permit of dirt and refuse getting in and interfering with the supply.

E.A.W. Activities.

The Manchester and Salford branch of the Electrical Association for Women spent an interesting afternoon at the new showrooms of the Salford Corporation Electricity Department on January 15th, when an attractive programme arranged by the city electrical engineer, Mr. Romero, included an instructive address on "Water Heating" by Mr. Kellet.

At a meeting at the offices of the Bristol Corporation Electricity Department, on January 15th, a new local branch of the Association was formed. The chair was taken by the Hon. Mrs. J. H. Inskip, and the chief speaker was Miss C. Haslett, director of the Association. Mr. H. Faraday Proctor, chief engineer and manager of the Bristol undertaking, spoke highly of the Association, and reminded those present of the service rendered by women during the war, when, with only a few days' training, they took over the running of the sub-stations.

Turbo-electric Ships.

The American Ward Line announces that two turbo-electric driven ships, to cost £2,000,000, have been ordered for the New York-Havana service, to be completed by November, 1930.

New Einstein Theory.

Professor Einstein has handed to the Prussian Academy of Science manuscript the contents of which are stated to be more important than those of his first paper on Relativity. The theme of the new work is the reconciliation of the laws of mechanics with the laws of electro-dynamics. Professor Einstein has spent 10 years in arriving at the conclusions which he presents, says the *Daily Mail*, but the whole work occupies only five typewritten pages. The manuscript will be published by the Academy.

Educational.

A special course of five lectures on "Electrical Sub-stations" is being given on Tuesday evenings, from January 22nd, 7-9 p.m., at the School of Engineering and Navigation, Poplar, by Mr. H. Brazil, M.I.E.E. Fees for the course to persons in the trade and eligible for admission at the London fee are: over 21 years of age, 3s. 4d.; under 21, 1s. 8d.

Scottish Hydro-Electric Schemes.

Professor F. G. Baily, Professor of Electrical Engineering in the Heriot-Watt College, Edinburgh, examines in an article in *The Scotsman* some of the hydro-electric power schemes which it is proposed to carry out in Scotland. The Loch Hourn scheme in West Investness-shire, Professor Baily considers, must attract a factory to an otherwise unsuitable site or fail in its object. Probably a supply to Inverness and Dingwall would cost more at those places than a supply from water power nearer at hand or from a steam power station. The Galloway scheme must show itself to be more economical than a steam station, but as the latter will either be moderate in size and not fully economical, or at a considerable distance, the scheme will be able to stand a higher total cost than the Loch Hourn undertaking, and will be of considerable benefit to the people of the whole valley and of the neighbouring towns. The Grampian group of stations can achieve financial success only if the constructional cost is exceptionally low. There must be a long length of unprofitable line to the Dee and Tay valleys, which can be supplied from Aberdeen and Dundee with lines feeding populous districts all the way. The initial cost of the Loch Luichart (Ross-shire) scheme seems likely to be moderate, and the outlets for power, Dingwall and Inverness, with small towns on the way, are within reasonable distance. Referring to the one scheme in operation, that of Kinlochleven, Professor Baily declares that, owing to many favourable conditions, the complete success of this scheme cannot be taken as typical. Except during the period of construction, these schemes need not cause serious injury to the appearance of the countryside, says Professor Baily. Raw scars on hillsides will soon become green again; pipe lines can be hidden by judicious planting; overhead wires in remote parts will be insignificant, and in populous areas their benefits will outweigh their inelegance.

Appointments Vacant.

Lady demonstrator and showroom assistant (£160) for the Corporation of Worcester Electricity Department. Secretary (£700) for the Incorporated Municipal Electrical Association. Charge engineer for the Lancashire Electric Power Co. Probationary assistant telegraph engineers for the Government of Nigeria. Shorthand-typist (male) (£95) for the borough of Hackney Electricity Department. Junior technical officer (£259) in the Admiralty Design Section, Portsmouth. Working foreman for the Engineering Department of Worcestershire Mental Hospital. (See our advertisement pages to-day.)

Association of Supervising Electrical Engineers.

The Association will hold its annual dinner on February 23rd, at the Hotel Cecil, when the president, Mr. S. B. Donkin, M.Inst.C.E., will occupy the chair, and will be supported by many guests distinguished in the engineering world.

Automatic Traffic Signals in Glasgow.

The Glasgow Magistrates Committee has recommended that as an experiment a set of Messrs. Barber & Colman's automatically controlled traffic signals be erected in the city, at an estimated cost of £130.

E.P.E.A. Technical Group Dinner.

The London Local Technical Group of the Electrical Power Engineers' Association has arranged to hold a dinner and dance at the New Princes Galleries, Piccadilly, on March 16th. Dinner will be served at 7 p.m., and dancing will end at midnight. The number of tickets to be issued is limited to 250, and they can be obtained from the Hon. Secretary, 14, Violet Road, E.3, price 15s.

The Montefiore Prize Competition.

We have received from the Administrative Council of the Association des Ingénieurs Electriciens, of Liége, particulars of the competition named "Fondation George Montefiore," a triennial event which is to be awarded this year, the prize amounting to 29,000 francs. Particulars were given in our issue of April 6th, 1928; works submitted in competition must be received by the Secretary, 31, Rue Saint-Gilles, Liége, Belgium, not later than April 30th, 1929.

The Bakery Exhibition.

The display of electrical equipment designed for the grocery and baking trades at the exhibition promoted by the Birmingham and District Associations, at Bingley Hall, Birmingham (from January 15th to 24th) was of special interest. It marked a considerable advance in the utilisation of electricity, particularly in bakeries, and it is a noteworthy fact that almost every set of apparatus was electrically driven. A complete all-electric working bakery, including oven and a range and dough-mixing and kneading machines, cake-mixing machines, bun dividers and working tables, was shown by the Artofex Engineering Works (London). Interesting features included a two-deck electric oven, with an electrically-heated prover, and a tempering tank for providing hot water for the dough. The equipment is extremely compact, thus requiring a minimum of floor space and, apart from health considerations in relation to the operative, emphasis was properly laid on the importance of continuous baking. It was pointed out that with the electric oven there was no waiting between the batches; consequently use could be made of a smaller oven for the same output, when compared with fuel-fired ovens; and, moreover, the output is relatively higher.

Another interesting display of apparatus was made by the Peerless Electrical Manufacturing Co., of London, and included cake-mixers and whisks, and high-speed dough mixers, coffee mills, slicers, mincers and dish-washers.

Messrs. Russell & Co., Birmingham, were responsible for a good exhibit, in which electrically-driven cake and whisking machines, dough machines and potato machines occupied an important place.

Automatic electrical refrigerators specially designed for the baking and allied trades were shown by Frigidaire, Ltd., of Birmingham. One of several models was for the storage of cream, liqnid eggs, bakery fats, and other perishable foods, operated by a ¼-h.p. air-cooled compressor; another was designed for the needs of the smaller restaurants, caterers, and dairies; a third model, which takes the form of a counter case, provides for efficient refrigeration and suitable display of perishable goods.

Working demonstrations were given by Messrs. John Hunt (Bolton), Ltd., of a pie- and tart-making machine, and a new cold moulding attachment for various classes of confectionery. Some very effective little cake-making machines (electrically-driven) were shown. Messrs. T. Collins & Co., Ltd., of Bristol, showed a dough-making machine of the revolving type, self-contained with tempering tank, sifter, and electric motor. Four models were displayed by Milkanic Emulsors, Ltd., of London, each machine being fitted with its own electric motor to suit the voltage required by any customer.

Other exhibitors were Mr. W. E. Burnell, Leicester; the Hobart Manufacturing Co., London; Mr. G. Tweedale, Leeds; the C. O. Ericsson Engineering Works, Birmingham; Messrs. Berkel & Parnell's Slicing Machine Manufacturing Co., Ltd.; and British Weighers & Slicers, Ltd., Sheffield.

Midland Electrical Engineers' Ball.

As a result of the very successful Midland Electrical Engineers' Ball, held at the Grand Hotel, Birmingham, on November 16th last, the Committee (President, Mr. R. A. Chattock, M.I.E.E., city electrical engineer, Birmingham), has instructed the honorary secretary, Mr. W. Y. Anderson, A.M.I.E.E., to forward the gratifying sum of 75 guineas, for the second year in succession, as a donation to the Benevolent Fund of the Institution of Electrical Engineers.

Short-circuit Capacity.

In an article in the January issue of *Distribution* (Henley's journal) Mr. W. H. Nichols draws attention to the magnitude of the short-circuit currents that are now attainable at consumers' terminals, owing to the growing density of supply and the multiplication of sub-stations. In the case of a consumer close to a sub-station, "with almost unlimited power behind the transformers, and an impedance of only two or three per cent. in the transformers, the short circuit which could be obtained at service terminals only a few yards from the bus-bars would be enormous." Fortunately most faults are of appreciable resistance, and it is seldom that a good solid contact is made between cores. Moreover, the fine wire used in service cut-outs fuses before the short-circuit current has time to rise to its maximum value; but where heating and cooling loads are met with, the cut-outs are more heavily wired. Hence where there is a dense load, only cut-outs of the most reliable type should be installed.

Radio Direction-finding.

In a paper recently published in the I.E.E. *Journal*, Mr. R. L. Smith-Rose, D.Sc., Ph.D., A.M.I.E.E., of the National Physical Laboratory, considers the applicability of the reciprocal theorem to the practice of radio direction-finding with either a rotating loop transmitter or a loop receiver. A description is given of some experiments carried out by the Radio Research Board with the object of demonstrating that the permanent errors to which a rotating-loop beacon transmitter may be subject as a result of condidtions local to its site are similar to those observed on a direction-finder erected on the same site. This similarity has materially assisted in locating the cause of the permanent error associated with the rotating beacon erected at Fort Monckton, near Gosport. From other experiments carried out under suitable conditions, it is shown that the occurrence of night errors is experienced with both systems of direction-finding to approximately the same extent.

Institution Notes.

Royal Institution.

On Thursday (January 31st) Sir William Bragg gives the first of three lectures on the "Early History of X-Rays."

Institution of Electrical Engineers.

INFORMAL MEETING.—At the meeting of the Institution held on January 14th (Mr. W. E. Lang in the chair), Major A. Jenkin opened a discussion on "Trolley Omnibuses." He sketched the evolution of the trolley-'bus up to the latest type of six-wheel vehicle, seating 68 passengers, and pointed out that the system was free from the great disability of the tramcar in that the 'bus could draw into the kerb, and could go round obstructions in its path. The chief advantage over the petrol omnibus was that it had better speed control, much quicker acceleration, and cheaper mileage, and further had the power of the electricity station behind it. In addition, it was anticipated that the cost of electric power would fall or remain stationary, whereas the cost of petrol would probably rise very considerably in the future.

Major Jenkin described in detail the latest developments in the construction of chassis, driving mechanism, the pole and shoe, motor and controller, and the deviation indicator, which steered a path under the trolley wire and enabled a 'bus to keep its course in the densest fog. In view of the trolley-'bus being on rubber tires, and without the earthed rails of the tramcar, insulation was of the utmost importance, and all current-carrying apparatus had to have the best possible protection, especially as regenerative braking was now common practice.

It had been found that contactors, which formerly jerked out, could be relied upon to stay in with pneumatic-tired vehicles. Trolley-'buses were the solution of the troubles of a tramway system faced with the enormous expense of relaying worn track.

Mr. W. A. Stevens described a system of regenerative braking operating most successfully at Wolverhampton with a compound motor weighing 19.5 lb. per h.p. By ingenious use of the series winding the current rise was limited, and did not affect the lamps.

Mr. C. J. Spencer said he had found contactors unsatisfactory on tramcars and had adopted a "line-switch" that obviated breaking in the controller. He thought regeneration with modern ventilated motors was thoroughly practicable and desirable.

A.M.I.E.E. EXAMINATION.—The results of the associate membership examination held in November, 1928, have been announced. The list of successful candidates shows 44 as having passed the whole examination, 13 as having passed Part I only, and one as having passed Part II only. The next examination will be held on May 29th, 30th and 31st, 1929. Candidates must (*a*) be either students or graduates of the Institution, or (*b*) have lodged with the secretary a duly completed form "E" for election as Associate Member and have been informed that they must pass the examination as a condition of election. Entry forms, which must be completed and returned by April 1st, and particulars regarding election to membership of the Institution may be had on application to the secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

Mr. P. DUNSHEATH, O.B.E., M.A., B.Sc., who has for the past nine years had charge of the research laboratories of Messrs. W. T. Henley's Telegraph Works Co., Ltd., has been appointed research and technical manager at the company's head office, Holborn Viaduct. The control of the laboratories at Gravesend is being taken over by Mr. W. C. Barry, B.Sc.

Professor F. C. LEA has been appointed president of Section G—Engineering, for this year's meeting of the British Association for the Advancement of Science which is being held in South Africa.

Messrs. Credenda Conduits Co., Ltd., Oldbury, Birmingham, have appointed Mr. C. ORRINGE, of Leicester, as their sales engineer for the East Midlands.

Mr. WILLIAM MACFARLANE, of the electricity department of the Glasgow Iron and Steel Co., Ltd., Wishaw, has been presented with wedding gifts by the staff.

Mr. WALTER R. STEAD, tramway inspector at Stockport, who is retiring after 23 years' association with the undertaking, has been presented by the officials with an inscribed gold watch. The presentation was made by Mr. A. T. Eardley, tramway manager.

Mr. E. J. BAKER, having resigned his position of outside representative after 25 years' service with the I.R., G.P. and Telegraph Works Co. (Silvertown Co.), was recently presented by his colleagues with a gold watch, chain and pendant. Mr. Baker is now representing the Lithanode Co., Ltd., of 190, Queen's Road, Battersea, one of the oldest accumulator manufacturers in this country.

The marriage took place last week at Rugby of Mr. E. V. NEWBERRY, chief of the test department at the Rugby works of the British Thomson-Houston Co., Ltd., and Miss HILDA BEATRICE OVER, of Rugby.

The recommendations regarding two new directors of the Bank of England to fill this year's vacancies are of interest electrically, for the names coming before the meeting of the General Court which was called for Wednesday, 23rd inst., were those of Sir BASIL BLACKETT, who is nominated for the chairmanship of the new Communications Company, and Sir A. R. DUNCAN, chairman of the Central Electricity Board.

The Industrial Australian states that Mr. T. MALCOLM RITCHIE, managing director of Metropolitan-Vickers, Ltd., left Sydney for London in December on a combined business and pleasure visit.

Mr. MERVYN SAUNDERSON, second assistant engineer with the Manx Electric Railway Co., Ltd., has accepted an appointment with John Jackson, Ltd., as electrical engineer on the construction of the new naval base at Singapore.

Mr. E. W. HILL, A.M.I.E.E., has been appointed chief engineer of Aron Electricity Meter, Ltd., in succession to Mr. F. A. Nield, M.I.E.E., who is retiring by medical advice on account of ill-health. Mr. Hill has for many years been associated with the electricity meter and instrument branch of the industry in this country and abroad. He was one of the moving spirits of the Meter Engineers' Technical Association, now transformed into the new Meter and Instrument Section of the I.E.E.

The Ioco Rubber and Waterproofing Co., Ltd., announces that Mr. E. J. KIRKLAND has been appointed as its sales representative for the whole of Yorkshire, with headquarters at Leeds, and Mr. J. CURRAN as sales representative for Liverpool and North Wales territory, with his headquarters at Liverpool.

The Hastings Town Council has increased the salary of the deputy electrical engineer from £600 to £650 per annum.

The North Western Branch of the Institution of Mechanical Engineers has elected Mr. H. L. GUY as chairman for the year. Mr. Guy, who was trained at the Cardiff University College, has been for some years Chief Engineer of the Mechanical Department of the Metropolitan-Vickers Electrical Company, and has been responsible for many important developments in steam turbine practice, including the design of some of the largest and most efficient sets which have been built in this country. For his last paper "The Economic Value of Increased Steam Pressures," presented to the Institution in November, 1926, and reproduced in our pages, he was awarded the Hawksley Gold Medal—the premier award in the gift of the Institution. He will present before a meeting of the Institution in Manchester on January 31st, a paper on the subject of "Some Tendencies in Turbine Design." The programme of the Summer Convention of the Institution, which is to be held in Manchester, will include a visit to the Metropolitan-Vickers works.

Mr. W. C. GOMERSALL, A.M.I.E.E., who has been in charge of the Power and Electrical Department of the Jardine Engineering Corporation, Ltd., for nearly ten years, has resigned his position and accepted the post of managing director of the China Engineers, Ltd., P.O. Box No. 1182, 24, Yuen Ming Yuen Road, Shanghai. This is a newly-formed concern, and Mr. Gomersall is now in England to make agency arrangements with manufacturers interested in the China market. His address is c/o Hongkong and Shanghai Banking Corporation, 9, Gracechurch Street, London.

At a recent meeting of the District Joint Industrial Council No. 7 (East Midland Area) for the Electricity Supply Industry, Mr. G. J. HOLLYER (borough electrical engineer of Loughborough) was presented with a gold cigarette case to mark his year of office as chairman of the Council.

Obituary.—MR. J. M. GORHAM.—We regret to report that Mr. John Marshall Gorham, M.I.C.E., M.I.E.E., died last week at the age of 75. Mr. Gorham was one of the sons of Dr. Gorham, of Tonbridge, and served his time in the shops of Messrs. Robey & Co., Lincoln, after leaving Tonbridge School. He carried out pumping and other contracts for them in Spain, and was in charge of their engine plant at the Crystal Palace Exhibition in 1881. Subsequently he was electrical engineer to the King of Rumania, and on his return he was engaged as works manager of the Electrical Power Storage Co. by Mr. Bernard Drake, who was managing engineer of that company. Subsequently he and Mr. Drake founded Drake & Gorham, Ltd., of which he remained a director, though failing health had prevented his taking any active part in the business for many years past. Mr. Gorham was for some time a director of the Daimler Company, which he joined at a critical time in the history of that concern, advancing it the money required to carry on. He was also a director of the D.P. Battery Co., Ltd. Mr. Gorham was an excellent mechanic, and was fond of making models of new scientific apparatus in his leisure time. His unobtrusive kindliness was appreciated by all who knew him.

SIR JOHN BRUNNER.—The death occurred on January 16th, in London, at the age of 63 years, of Sir John Brunner, eldest son of the late Sir John T. Brunner, who, with Dr. Ludwig Mond, founded the famous firm of Brunner, Mond & Co. He succeeded his father in the baronetcy in 1919. He was a director of Imperial Chemical Industries, Ltd., but resigned that position in 1927.

MR. A. H. MOSELEY.—The death occurred recently from injuries received in a motor accident of Mr. Arthur Herbert Moseley, of Finchley, who had for many years been with the British Thomson-Houston Co., Ltd., first at Rugby, and later in London. He entered the service of the company at Rugby in 1900, and during the war managed a large munition factory at Birmingham. He resumed his connection with the British Thomson-Houston Co. in 1924, since which time he had been at the London office.

DR. F. PRASIL.—The death is announced from Zurich, at the age of 72 years, of Dr. Franz Prasil, professor of Engineering at the Swiss Eidgenossiche Technical High School. The deceased was an authority on water turbines for hydro-electric power stations.

MR. F. HARDING.—The death took place on January 12th of Mr. Frank Harding, who was, until his recent retirement, manager of the Derby Corporation Tramways. He was 71 years of age, and commenced his connection with tramway services at Leicester. He subsequently became manager of the Derby Tramways Co., Ltd., and continued in charge when the undertaking was acquired by the Corporation.

Will.—Mr. J. H. JONES, manager of the cable depôt of the Eastern Extension Telegraph Co. at Singapore, left £12,263 gross and £12,031 net personalty.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Chelmsford Radio, Ltd.—Private company. Registered January 11th. Capital, £1,350 in £1 shares (800 ordinary and 550 7 per cent. preference). Objects: To acquire the business of dealers in wireless apparatus, gramophones and electrical goods carried on by H. J. Hawkes and D. C. Clark, at 76, Duke Street, Chelmsford, as the Chelmsford Radio Co. The directors are:—D. C. Clark (chairman), Newhaven, Rainsford Lane, Chelmsford, Essex, engineer; C. J. Deal, The Limes, Kelvedon, Essex, motor engineer and agent. Registered office: 76, Duke Street, Chelmsford, Essex.

Mayfair Enterprises, Ltd.—Private company. Registered January 17th. Capital, £1,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in all kinds of gramophones and radio, musical, electrical and other instruments and apparatus for use with them; public and private contractors, motor, electrical, mechanical or other engineers, &c. The directors are:—T. A. B. Ternan, 44, Oxford Terrace, Hyde Park, W.1; A. Harvard-Watts, St. Martin's Chambers, Leicester Square, W.1. Registered office: 37, Bruton Street, Bond Street, W.1.

Electric News Panels, Ltd.—Private company. Registered January 17th. Capital, £20,000 in £1 shares (10,000 8 per cent. cumulative preference and 10,000 ordinary). Objects: To carry on the business of signwriters, advertising experts and contractors, publicity agents, manufacturers of and dealers in signs, electrical and mechanical engineers, &c. The subscribers (each with one share) are:—F. W. Eve, 101, Salisbury House, London Wall, E.C.2, cashier; G. F. Smallpiece, ditto. Registered office: 31-33, Bishopsgate, E.C.

Vale-Royal Electric Lamp Manufacturing Co., Ltd.—Private company. Registered January 17th. Capital, £100 in £1 shares. Objects: To carry on the business of electrical and wireless engineers, designers and manufacturers of and dealers in lamps, globes, brackets, dynamos, &c. The permanent directors are:—J. Jones, 13, Vale Royal, Islington, N.7; W. E. Pinder, 7, Little Goodge Street, W.1; T. B. Aldridge, 6, Plevna Road, Tottenham, N.15.

M.E.D.A.S., Ltd.—Private company. Registered January 11th. Capital, £3,150 in 2,500 7 per cent. cumulative preference shares of £1 each and 13,000 ordinary shares of 1s. each. Objects: To acquire the business of electrical, radio, lighting and heating engineers carried on by A. C. L. Covell and D. J. Quenzer at 185, Hammersmith Road, W., as the Modern Electrical Development and Supply Co. The subscribers (each with one ordinary share) are:—A. C. L. Covell, 185, Hammersmith Road, W.6, electrical engineer; C. L. Porter, 397, Fulham Road, S.W.10, accountant. The first directors are:—A. C. L. Covell and D. J. Quenzer (both permanent). Secretary: C. L. Porter. Registered office: 185, Hammersmith Road, W.6.

British Power & Light Corporation, Ltd.—Private company. Registered January 14th. Capital, £100 in £1 shares. The objects are to promote companies, syndicates and partnerships of all kinds, particularly those to carry on the businesses of electrical and general engineers and manufacturers and maintainers of plant for the generation, accumulation, transmission and supply of electrical energy for the purposes of light, heat and power; to carry on business as bankers, capitalists, financiers, concessionaires, &c. The subscribers (each with one share) are:—T. G. Greenleaf, 36, Sistova Road, Balham, S.W.12, clerk; E. J. Burrows, 29, Lyndhurst Road, Highams Park, E.4, clerk. Solicitors: Herbert Smith & Co., 62, London Wall, E.C.2.

Jerusalem Electric & Public Service Corporation.—Additional particulars of the Jerusalem Electric & Public Service Corporation, Ltd., were filed on January 2nd, pursuant to Section 274 of the Companies (Consolidation) Act. The capital is £P500,000. The company was incorporated in Palestine on July 3rd, 1928, to acquire concessions (1) for generating, supplying and distributing electrical energy, and (2) for supplying and distributing potable water in Palestine. The British address is at 66, Queen Street, E.C.4, where T. K. Anderson is authorised to accept service of process and notices on behalf of the company. The directors are:—W. Shearer, Inglewood, Chislehurst; Sir John H. Brunel, Ardkinglas, Inverary, Scotland; Major Sir Archibald Boyd Boyd-Carpenter, M.P., River House, Walton-on-Thames; L. L. Le Bouvier, Ottoman Bank, Jerusalem; and J. G. B. Stone, Muir House, Broadwater, Worthing.

Official Returns of Electrical Companies.

Attaix, Ltd.—H. C. Merrett, of 32, Finsbury Square, E.C.2, was appointed receiver and manager on December 14th under powers contained in debenture dated May 16th, 1928.

City of Oxford Motor Services, Ltd. (formerly City of Oxford Electric Tramways, Ltd.).—Satisfaction to the extent of £2,000 on December 31st, 1928, of charge dated February 20th, 1914, securing £46,000.

Chloride Electrical Storage Co., Ltd.—Debenture charged on freehold and leasehold property at Clifton, Lancs., and the company's undertaking and property, present and future, including uncalled capital dated December 29th, 1928, to secure all moneys due or to become due from the company to Lloyd's Bank, Ltd.

Vactite Wire Co. (1919), Ltd.—Capital, £25,000 in £1 shares. Return dated November 9th, 1928. 15,000 shares taken up. £3 paid. £14,997 considered as paid. Mortgages and charges nil.

Faulkner & Co. (Manchester), Ltd.—Capital, £2,000 in £1 shares. Return dated October 22nd, 1928. 1,900 shares taken up. £500 paid. £1,400 considered as paid. Mortgages and charges nil.

Electric Reduction Co., Ltd.—Capital, £50,000 in 16,200 preference and 33,800 ordinary shares of £1 each. Return dated November 2nd, 1928. 16,200 preference and 28,800 ordinary shares taken up. £18,000 paid on 13,000 preference and 5,000 ordinary shares. £27,000 considered as paid on 3,200 preference and 23,800 ordinary shares. Mortgages and charges, £25,000.

Drake & Gorham, Ltd.—Capital, £125,000 in £1 shares. Return dated November 13th, 1928. All shares taken up. £85,000 paid. £40,000 considered as paid. Mortgages and charges, £12,000.

Rudolph Charles & Goff, Ltd.—F. Hyde, of 34, London Wall, E.C.2, ceased to act as receiver or manager on August 28th, 1928. (Notice filed January 9th, 1929.)

City Notes.

Prospectus.

Einstein's Electro-Chemical Process, Ltd.—On Thursday last week the public was invited by advertised prospectus to subscribe for an issue of 250,000 8 per cent. participating preference shares of £1 each and 250,000 ordinary shares of 4s. each, and the list was closed by 10.30 a.m. on that day owing to oversubscription. The company, whose offices are at 16, St. Helen's Place, and of which Mr. Wladimir I. Einstein is managing director and Mr. James Swinburne, F.R.S., is consulting engineer, has been formed to acquire the world rights available to the vendor of the patent process described in the prospectus, "with all the secret processes used in connection therewith, improvements and future inventions relating thereto." The inventions are for processes enabling "practically all kinds of materials of any shape or contour to be metallised by electrochemical action to any desired thickness." The price payable to the vendor for the world rights is £210,000 (£40,000 cash and the rest in 850,000 fully-paid ordinary shares of 4s. each). He will also receive certain royalties and a percentage of the net profits. It is stated that Mr. Einstein has already expended in the course of the last three years a sum considerably in excess of the cash consideration mentioned. He has equipped the Paris factory and paid the costs of experimental work, and carried out financial negotiations. The issue will provide £210,000 for working capital and general purposes. A report by Mr. J. Swinburne, F.R.S., is printed in the prospectus, from which it appears that the processes consist in the electro-deposition of metals, especially on non-conducting materials, such as wood, glass, porcelain, and textile fabrics; thus the wooden propellers of aeroplanes can be completely encased in metal, greatly increasing their strength, thin fabric can be made gas-tight and non-inflammable, ships can be copper-bottomed, and furniture can be made immune to the attacks of the white ant in the tropics. Glass and porcelain can be beautifully de-

corated, says Mr. Swinburne, who has seen "the small experimental works in Paris," and states that the capital outlay on plant and the running cost of the process are both very small, whilst the field of application is very diversified. Four British patent applications have been accepted, two of which have been actually granted, and three other applications have been lodged; patents in many foreign countries have also been applied for.

Ward & Goldstone, Ltd.

Notices were issued to the shareholders last week calling extraordinary general meetings for January 24th for altering certain of the Articles of Association respecting the nominal value of the ordinary shares, and the rights of the preference shares to participation in the profits after they have received their 7 per cent. It is proposed to change 100,000 ordinary shares of £1 each into 400,000 ordinary shares of 5s. each, making the capital 100,000 preference shares of £1 each and 400,000 ordinary shares of 5s. each. If these alterations are approved the following resolution will be submitted, and it will be submitted for confirmation at a meeting to be held on February 14th: "That the sum of £8,000, part of the undivided profits of the company, be capitalised and issued as fully-paid ordinary shares of 5s. each, ranking *pari passu* in all respects with the existing issued ordinary shares, and that such shares be distributed amongst the members holding preference shares on the register on April 1st, 1929, in the proportion of four newly issued ordinary shares of 5s. each for every ten preference shares of £1 each held by such members on that date."

Kiesselbach Steam Accumulators, Ltd.

To conform with Stock Exchange requirements, this company published on Monday last a statement of its constitution and objects. It was registered on January 16th with a capital of £220,000 (210,000 "A" shares and 10,000 "B" shares of £1 each). The directors are Brig.-Gen. Sir Henry P. Maybury, G.B.E. (chairman), Mr. J. E. Dunning, Mr. Frank Hodges, Mr. S. Hopkins (managing director, formerly general manager of the Fairfield Howden Ruths Steam Accumulators, Ltd.), Mr. W. Y. Lewis (general manager, late managing director and chief engineer of the British Niclausse Boiler Co., Ltd.), Mr. G. E. Usher (general manager and director, International Combustion, Ltd.), and Mr. H. D. Williamson. The registered office is at 31, Lombard Street, E.C.3. The company is acquiring rights for the manufacture and sale in the British Empire and the United States of thermal storage plants from Messrs. Sach & Kiesselbach and Dr. Kiesselbach. Hitherto the plant in question has been made in Germany only. Negotiations are proceeding for the disposal of the American rights.

Haslam & Newton, Ltd.

This company is an amalgamation of the interests of Newton Bros. (Derby), Ltd., and the Haslam Foundry & Engineering Co., Ltd. The statutory meeting was held on January 15th, when Mr. J. H. Lord (chairman), who presided, said that the "Newton" side of the business was busy and profitably employed, and was looking forward to an increased turnover with satisfactory results. This section of the company had accomplished something of a feat by securing a contract from the German Government for e.h.p. direct-current generator equipment in which it specialised. Certain further developments on the electrical side were under consideration; the management was keeping a sharp look-out for all possible avenues of new business.

Official Notice Re Companies.

The names of the undermentioned companies are to be struck off the Register unless cause to the contrary is shown within three months:—

Bell Battery and Accessory Co., Ltd.
C.A.T. Cable Co., Ltd.
Clayton Motors, Ltd.
Export Electric Fittings Co., Ltd.
Hamilton Wells Electro-Medical Institute, Ltd.
Northern Lift and Electrical Co., Ltd.
Premier Telephone and Wireless Co., Ltd.
Radio Service Co. (Birmingham), Ltd.
Watford Radio Supplies, Ltd.
Wireless Headphone Distributing Co., Ltd.

Brazilian Traction, Light and Power Co., Ltd.

The company announced this week that the Federal Supreme Court of Brazil has upheld the validity of the concession granted some years ago by the City of Rio de Janeiro to the company's subsidiary, the Brazilian Telephone Co. It is stated:—"Some time must necessarily elapse before it can be definitely stated that the question is finally disposed of, but the company's hope is that this time will be reduced to a minimum, so that it may be free to give the public in the City of Rio de Janeiro the telephone service it has long wished to supply."

City of London Electric Lighting Co., Ltd.

This company has presented a petition to the High Court for confirmation of an extension of its objects to enable it to acquire rights and privileges with regard to the Bankside Investment Trust, Ltd., and to guarantee obligations of that company. The petition is to be heard in the Chancery Division on January 28th by Mr. Justice Romer.

S. Smith & Sons (Motor Accessories), Ltd.

The holders of the company's preferred and deferred shares are offered new shares of their respective classes in the proportion of one new share for each three held. The total issue will amount to 50,000 preferred shares of £1 each and 280,000 deferred shares of 1s. each. The issue price of the preferred is 30s. and that of the deferred 3s.

Western Union Telegraph Co.

The earnings report for the past year, with the December figures estimated, shows a gross revenue of $139,244,596, against $134,460,816 in 1927. The available balance is given as $18,983,074 (against $18,614,784), and after deducting interest on bonded debt there is a net income of $15,373,669, as compared with $15,030,453.

Traction and General Investment Trust, Ltd.

The report for the year ended December 31st last records a net profit of £74,432, as compared with £59,980 in 1927. To this is added £31,922 brought forward, making £106,354. The directors propose to transfer £10,000 to the reserve account and to pay a final dividend of 10 per cent. on the ordinary stock, making 16 per cent. for the year as compared with 15 per cent. for 1927. This leaves £35,788 to be carried forward. Meeting: January 31st.

Delhi Electric Supply and Traction Co., Ltd.

An interim dividend of 4 per cent. has been declared.

Stocks and Shares.

MONDAY EVENING.

IT is becoming almost monotonous to refer to the increase of strength that, with rare exceptions, characterises the Stock Exchange markets week by week. Members of the House admit, in talking to each other, that they find a difficulty in seeing where the business comes from, but the fact remains that most of the markets are well occupied with orders, and that the strength of prices is satisfactorily maintained. No doubt can be felt that a good part of the demand arises from America, where, according to commonly-accepted theory, most of the world's money went during and after the war. Of recent months the Americans have developed a strong taste for gambling: many prices have risen 20, 50, 100, or even more points within a comparatively brief space of time. This activity is reflected, to some extent, in shares negotiated on this side, of which the principal, from the market point of view, is Mond Nickel, where there has been an enormous wave of buying, and a remarkable appreciation in the price of the shares. Within the past week or so attention has become more closely riveted than previously upon shares in Rhodesian copper companies, and this, in its turn, served to impart energy to Victoria Falls & Power ordinary and the preferences, which stand at 62s. 6d. and 33s. 9d., respectively.

Electricity Supply Shares.

The capital required by 1936 for the latest scheme published by the Central Electricity Board is set down as being £2,907,000, but further contemplated expenditure is estimated as likely to raise the total to over eight million pounds sterling before the end of 1941—that is to say, within about thirteen years. The market effect of this scheme has been slight, as was the case, also, of the announcement of the previous schemes. It is felt more in the demand for shares in the manufacturing and equipment companies than in those of electricity supply issues. Yorkshire Electric Power ordinary are 1s. 6d. harder at 36s. 6d. The company's 6 per cent. preference, upon which a half-yearly dividend is due, stand at 24s., and the 5½ per cent. redeemable debenture stock is quoted at 102, the next interest being payable two months hence. The provincial list of shares is steady as a whole. Urban ordinary repeated their florin rise of last week, and are now 40s. 9d. Clyde Valley shares have advanced to £2.

London Companies' Dividends.

Electric Supply Corporation shares shed 1s. 9d. of their last week's gain of 7s. 3d., the price reacting to 56s. 3d. Amongst the London issues, County ordinary have gone back to 47s. 6d., and Charing Cross ordinary to 26s. Metropolitans maintained their improvement to 2¾. Tardy acknowledgment is made of the misleading character of yields calculated upon London electricity supply shares, in taking—as the basis for working out the returns upon money invested—the dividends at present being paid upon ordinary shares in the majority of London electricity supply companies. It is conceivable, of course, that the latter may be able to effect such economies in working, or to so increase their profits that larger dividends than 7 per cent. can be distributed after 1931. Safety demands, however, that the 7 per cent. scale shall be regarded as the probable rate of dividend, and this is a factor which investment must bear closely in mind.

The Eastern Telegraph Group.

The considerable rises which occurred last week in the stocks of the Eastern Cable quartette have not been entirely held. There are, indeed, falls amongst the leaders of the group, Eastern ordinary going back to 267½, a decline of 2½ points, while the shares of the three associated companies are also easier. The reaction is trivial as compared with the substantial advances which took place beforehand. It is stated in the Stock Exchange market that everything stands ready for the issue of the new securities into which Eastern stock, Eastern Extension and Western Telegraph shares are to be exchanged. At this eleventh hour, shareholders in the three companies are unaware of what they are about to receive. It is assumed that the proprietors will be offered, for each £100 of their present interest, £110 in 5½ per cent. preference stock, £165 in 7½ per cent. ordinary, and £25 in deferred. If the expectation prove correct, and if the further anticipation is realised that the new stocks will be valued at their par levels, a total of £300 is reached. Eastern ordinary, as just mentioned, stands at 267½. Eastern Extensions and Westerns are both 26¼. All three allow, therefore, for the margin of uncertainty which exists, both in regard to the precise distribution that will be made, and to the possible market prices of the new stocks when the latter become negotiable.

Wireless Shares.

The element of uncertainty is present still more strongly in the case of Marconi shares. This, coupled with neglect on the part of New York, accounts for the price being practically unchanged at 3⅞. Canadian Marconis are equally languid, and the price is lower at 35s. Burndept Wireless have strengthened to 7s. 3d.

Cables and Telephones.

Stocks and shares in other cable companies are mainly on the up-grade. It looks anomalous to see Anglo-American Telegraph deferred stock quoted at 26½, while the preferred is 103½, for the deferred receives a fourth of the dividend paid on the preferred, and the prices of the stocks should maintain correspondence. The deferred carries, however, 1½ per cent. dividend, which it will be ex on Thursday in this week, when the preferred will have 30s. per cent. taken from its price. The preferred dividend is paid four times, and the deferred once, a year. Indo-Europeans have again forged ahead; at 51½ the price is 2½ up. Great Northerns rose 10s. to 34½. This made a gain of £5 in three weeks. Direct Spanish are better at 10⅞. Amongst the telephone shares, United River Plates hardened to 12½, a gain of 7s. 6d., on a jump, started in New York, in the price of stock in the International Telephone & Telegraph Company which offered to take over United River Plate shares in exchange either for cash or for part cash and part of its own stock.

Indian and Foreign.

Atlas Light & Power went back to 23s. 3d. upon the cessation of the burst of American buying which forced up the price to 25s. Brazilian Tractions rallied to 82½, on support induced by the bonus announcement mentioned here last week. The new issue will require about six million pounds sterling for its satisfaction. Calcutta Electric Supply ordinary shares are better at 38s. 6d., and Madras Electrics show a rise at 35s. Burma Electric Supply ordinary changed hands lately at 18s. 9d. The 6 per cent. preference were last dealt in at 18s. 3d., early in December. Cawnpore Electric ordinary marked, a few days back, at 34s. 6d., and Delhi Electric Supply & Traction at 55s. East African Power & Lighting were done last week at 29s.

Manufacturing and Equipment.

The chief feature amongst shares in the manufacturing companies is a recovery in General Electrics to nearly 3. Reports credit the Americans with being responsible for the buying which put up the price. British Aluminium have gone back to 48s. 3d., after the brisk rise that took them to 2½. British Insulated are better at 4 7/16. Metropolitan-Vickers ordinary receded to 35s., Enfields to 5 5/16, Callenders to 4¼. English Electric ordinary rose to 8s. 9d. Everlite shares had a jump to 11s. 6d., then reacted a few pence. A lively business is being done in Ever-Ready Trusts, and the shares, with 10s. paid, command a small premium. Ever-Ready shares drooped to 31s. 3d. on profit-taking sales that followed upon the new issue. On a fairly general buying tip, Automatic Telephones rose to 2 1/16, and International Automatics to 2. It is not unlikely that the prices will go better. American Telephone and Telegraph shares went up to 207½.

Miscellaneous Matters.

Pennsylvania Water & Power at 86½ and Shawinigan common shares are both better. The rubber share market has been good, but prices eased off from the top, on a reaction in the price of the produce to 10d. per lb. Iron and steel shares are steady; Vickers vary narrowly between 12s. 9d. and 13s. Several new companies are contemplated for the exploitation of coal, and of metal processes.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1926.	Dividend. 1927.	Price Jan. 21, 1929.	Rise or fall.	Yield. p.c.
	£					
Bournemouth and Poole	1	14†	15	68/6	—	... ...
Brompton Ordinary	1	8⅝	8½	27/-	—	5 8 8
Charing Cross Ordinary	1	8½	8½	26/-	—6d.	5 7 8
do. do. 4½% Pref. ...	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8⅝	8⅝	27/-	—	5 8 8
City of London	1	10	10	32/-	—	4 7 6
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	2	+1/-	4 2 0
County of London	1	7½	7½	47/6	—1/6	3 3 0
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Edmundsons' 7% Pref.	1	7	7	25/-	—	5 12 0
Elec. Supply Corporation	1	11	11	56/3	—1/9	3 18 3
Kensington Ordinary	1	8	8	26/6	—	5 5 [illegible]
Lancs. Light and Power	1	7½	7½	30/-	—	5 0 0
London Electric	1	8½	8½	26/-	—	5 7 [illegible]
Metropolitan	1	8	9	47/6	—	3 15 8
do 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6	6½	30/-	—	4 6 8
Mid. Elec. Power	1	—	15	2 5/16	—	... ...
Newcastle-on-Tyne Ordinary ...	1	5	6	27/-	—	4 9 0
do. 7% Pref. ...	1	7	7	26/6	—	5 5 8
Notting Hill 6% Pref.	10	6	6	10⅝	—	5 11 1
North Met. Elec. 6% Pref. ...	1	6	6	23/-	—	5 4 4
St. James' and Pall Mall	5	8	8	27/6	—	5 1 10
Scottish Power	1	8	8	39/-	—	4 17 0
South London	1	8½	8½	27/6	—	5 2 8
Urban Ordinary	1	7	7	40/9	+2/-	... ...
Westminster Ordinary	1	8½	8½	27/-	—	5 3 8
Whitehall Elec. Invst. 7½% Pref....	1	7½	7½	24/3	+3d.	5 3 8
Yorkshire Elec.	1	8	8	36/6	+1/6	4 7 8

†4% of which was tax free.

HOME RAILS.

Central London Ord. Assented ...	Stock	4	4	73	—	5 9 7
Metropolitan	,,	3	3	67	—½	4 9 7
do. District	,,	3½	4	80	—½	5 0 0
Underground Electric	£1	1½	5	27/-	—6d.	3 14 1
do. do. Income ...	Bonds	6	6	127	—2	4 14 6

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	103½	—	5 16 0
do. Def.	,,	1½	1½	26½	+⅛	5 13 2
Automatic Telephone	1	10	10	2 1/16	+1/16	4 17 1
Eastern Extension	10	10	10	26½xd.	—⅛	*3 15 6
Eastern Tel. Ord.	Stock	10	10	267½	—2½	*3 15 0
Globe Tel. and T. Ord.	10	10	10	25½	—⅛	*3 18 6
do. do. Pref.	10	6	6	11½	+⅛	5 9 1
Great Northern Tel.	10	20	20	34½	+½	... ...
Indo-European	25	10	10	51½	+2½	*4 17 1
Marconi	10/-	5	*10	3⅞	—	... ...
Marconi-Marine	1	8½	12½	9½	—	3 11 5
Oriental Telephone Ord.	1	12	12	21⅝	+1/16	... ...
United R. Plate Tel.	5	8	8	12½	+⅜	3 4 0
Western Telegraph	10	10	10	26½	—½	3 15 6

*Interim.

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	5½	8⅜	—	7 11 9
do. do. 2nd. Pref. ...	5	6	6	3 7/8	—	8 14 6
do. do. 5% Deb. ...	Stock	5	5	77½	—	6 9 0
British Electric Traction Def. Ord.	,,	—	—	700	+15	... ...
do. do. Pref. Ord.	,,	8	8	124	—	6 9 1
Brazil Traction	100	6	7	82½	—	2 8 6
Brit. Colombia Elec. Rly. Pcs. ...	Stock	5	5	95½	—	5 4 7
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	13/-	—	... ..
London United Tram Deb. ...	Stock	4	4	61	—	6 11 4
Mexico Trams. 5% Bonds	—	5	5	79	—	6 6 7
Mexican Light Common	100	Nil	Nil	84½	—	... ..
do. 7% Pref.	100	Nil	7	76½	—	9 3 0
do. 1st Bonds	—	5	5	79	+1½	6 6 7
Yorkshire (West Riding)	1	Nil	Nil	5/-	—	... ..

MANUFACTURING COMPANIES.

Babcock & Wilcox	1	13	15	3⅜	—	*4 5 9
British Aluminium Ord.	1	10	10	48/3	—1/8	*4 3 0
British Elec. Transformer Pref....	1	7	7	15	—	9 6 8
British Insulated Ord.	1	15	15	4 7/16	+1/16	3 7 6
Brush Ord.	1	10	10	28/9	—	6 19 2
Callenders	1	15	15	4¼	—1/16	3 9 10
do 6½% Pref.	1	6½	6½	1⅝	+1/16	5 4 0
Crompton Parkinson Ord.... ...	£/-	—	—	19/6	—	... ...
do. 8% Pref.	1	—	8	25/9	+9d.	6 4 8
Edison-Swan 1st. Pref.	1	7½	7½	25/9xd.	—	5 16 6
do. 5% Deb.	Stock	5	5	86½	—	5 15 7
Electric Construction	1	7½	7½	26/9	—	5 12 1
Enfield Cable Ord.	1	30	20	5 5/16	—1/16	3 15 6
English Electric	1	Nil	Nil	8/9	+1/16	... ...
do. do. Pref	1	8	Nil	10/-	—	... ..
Gen. Elec. Pref.	1	6½	6½	23/6	—	5 10 8
do. Ord.	1	7½	10	2 1/16	+1/16	3 8 0
Henley	1	25	25	5½	—	4 5 0
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	Nil	Nil	11/3	—	... ...
Johnson & Phillips	1	12½	10	36/3	—	5 10 8
Met.-Vickers Ord.	1	8	6	35/-	—1/16	... ...
do. Pref.	2	8	8	2⅛	—	5 16 8
Siemens Ord.	1	7½	7½	30/-	—	5 0 0
Telegraph Construction	12	10	10	25	—	*4 14 6

*Dividends paid free of Income Tax.

Our Foreign Electrical Trade.

Statistics and Comparisons.

THE publication of the foreign trade returns for December enables us to give particulars of that month's electrical exports and imports and also figures for the whole of 1928.

Considering first the December table (I), it will be seen that the exports were £214,159 down as compared with November. This can be accounted for by the Christmas holidays; in 1927 the fall from November to December was about £300,000. Consequently the fall was spread over most of the items, although there were four exceptions. The machinery section, as a whole, showed a decline of £139,466; insulated wires and cables fell by £71,302; and unenumerated electrical goods by £30,449. The greatest increase was recorded for submarine telegraph and telephone cable, while telegraph and telephone apparatus also showed a substantial rise. In the comparison with December, 1927, decreases again predominated. The largest was the fall of £61,660 in the value of exports of telegraph and telephone apparatus, but it may be explained that the exports of this class during December, 1927, were above the average. Insulated wires and cables fell by £16,547, and there was also a decrease in exports of the non-submarine telegraph and telephone class. Against this there was a substantial rise in the fluctuating submarine cable item (£33,160). In the machinery section satisfactory advances in traction motors and unenumerated machinery were partly offset by a fall in "other" motors and generators.

Although the total imports decreased by about £39,000 as compared with the previous month, the total (£620,865) was the third highest ever reached—the first and second being in November and October respectively. Consequently the figure for the last quarter of 1928 was considerably greater than ever before, being £1,931,446. The principal decreases in December, as compared with November, occurred in the cases of unenumerated goods and batteries and accumulators. The largest increase was shown by the machinery class, and there was a general rise in the case of telegraph and

Table I.—Exports and Imports during December, 1928.

	Exports.			Imports.			Re-Exports.		
	Electrical exports for Dec., 1928.	Inc. or dec. as compared with Nov., 1928.	Inc or dec. as compared with Dec., 1927.	Electrical imports for Dec., 1928.	Inc. or dec. as compared with Nov., 1928.	Inc. or dec. as compared with Dec., 1927.	Electrical re-exports for Dec., 1928.	Inc. or dec. as compared with Nov., 1928.	Inc. or dec. as compared with Dec., 1927.
Electrical goods and apparatus (unenumerated)	£216,767	— £30 449	+ £20 499	£139,148	— £28.500	+ £14.801	£7,258	— £1.401	— £1,005
Insulated wires and cables ...	221,449	— 71.302	— 16,547	74,665	— 4,564	+ 6.294	383	— 455	— 1,456
Glow lamps	47,382	— 3,010	— 6,637	22,695	— 765	— 35,191	1,390	+ 605	+ 263
Arc lamps and parts ...	2 133	— 474	+ 933	2,518	— 816	— 1,842	10	— 49	— 382
Batteries and accumulators ...	85,904	+ 2.737	— 3 695	80 248	— 31.110	+ 311	1,815	+ 559	+ 201
Meters and instruments ...	22.100	— 15,238	— 11,388	24 232	+ 2.088	— 4,904	605	+ 267	+ 123
Carbons	411	— 134	— 236	9,863	— 5,758	+ 430	331	+ 262	+ 264
Switchboards (not telegraph or telephone)	5,717	+ 781	— 2,137	154	— 497	+ 82	18	— 193	+ 18
Electrical Machinery—									
Electrical machinery (unenumerated)	309.411	— 54,013	+ 26.301	150,373	+ 14,385	+ 3,473	8,597	— 9,721	— 6,300
Railway and tramway motors	16 986	— 19,266	+ 8,846	—	—	—	—	—	—
Other motors and generators ..	186,377	— 66,187	— 10,661	—	—	—	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	56,591	— 21,017	— 13,179	6,698	+ 4,916	— 5,010	8	— 2	— 254
Submarine telegraph and telephone cable	51,137	+ 38,003	+ 33,160	5,950	+ 5.950	+ 5,950	—	—	—
Telegraph and telephone instruments and apparatus ...	213,073	+ 25,410	— 61,660	104.321	+ 5,273	+ 44,346	1,898	— 4,985	— 167
Totals	£1,435,438	— £214,159	— £36,361	£62[illegible],865	— £38,918	+ £28,740	£22,313	— £15,113	— £8,695

Table II.—Exports of Electrical Machinery.

Destination.	Dec. 1927. £	Dec. 1928. £		Inc. or dec. £	1927. £	1928. £		Inc. or dec. £
European Countries	59.297	93,364	+	34,067	970 003	1,106,361	+	176 358
Japan	6,858	2.522	—	4.336	318 587	181.779	—	136,808
South America	44,795	37.080	—	7,715	576,961	773 7[illegible]	+	196,836
South Africa	57.168	53,403	—	3.765	1,041.504	464,944	—	576 560
British India	105,0 9	118.432	+	13,413	1,152,704	1,512.511	+	359,8[illegible]7
Australia	64,416	54.404	—	10,012	1,254,957	971,995	—	282,942
New Zealand	44,577	28.874	—	15,703	426 738	358.889	—	67.849
Canada	16,666	28 901	+	12.235	238. 94	252,758	+	14,564
Other Countries	89,452	95,794	+	6,342	771,189	1,081,450	+	310,261
Totals	£488,248	£512,774	+	£24,526	£6,710,817	£6,704,484	—	£6,333

telephone cable and material. The importation of submarine cable is a very infrequent event. The December, 1928, imports rose by £28,740 above those of the previous December. The item contributing most to this increase was telegraph and telephone apparatus, although unenumerated goods and insulated wires and

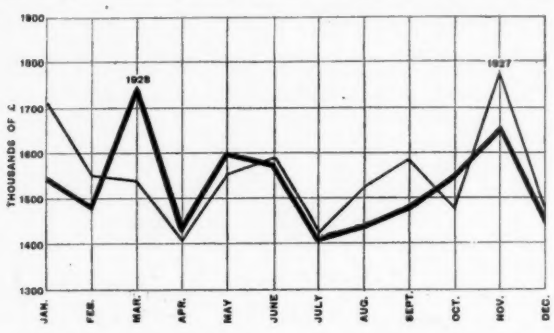
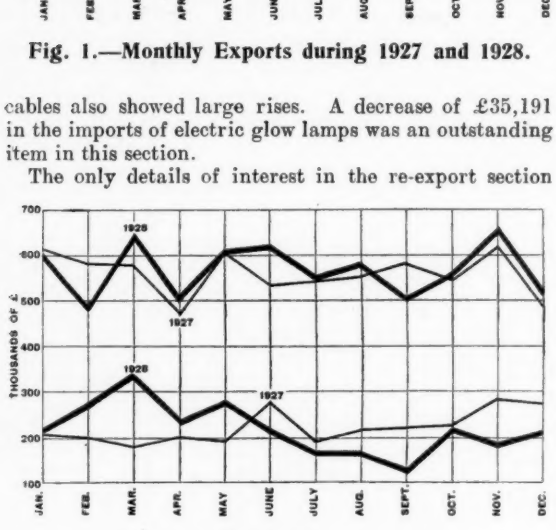


Fig. 1.—Monthly Exports during 1927 and 1928.

cables also showed large rises. A decrease of £35,191 in the imports of electric glow lamps was an outstanding item in this section.

The only details of interest in the re-export section

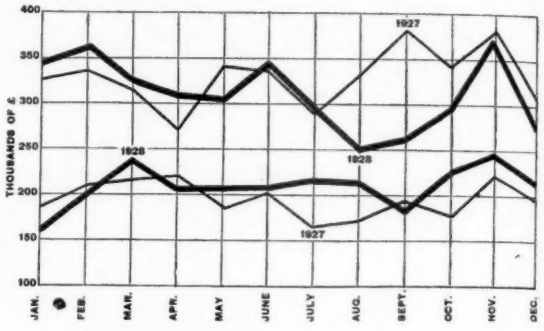


Upper Curves: Electrical Machinery.
Lower Curves: Telegraph and Telephone Apparatus.

Fig. 2.—Two Leading Export Items.

are the decreases in the machinery and telegraph and telephone apparatus classes.

Our second table shows the distribution of electrical machinery exports during December and the whole of the past year. The most prominent fact in the year's list is the reduction of £576,560 in the value of electrical machinery shipped to South Africa; this is another phase of the generally unsatisfactory condition of trade with the Union. The shares of Australia and New Zealand also declined, that of the former by £282,942. We can place against these a rise of £359,807 to the credit of India, which raises her to the first place, *vice* Australia. Japan's purchases fell very considerably, but on the other hand there were larger shipments to South America, Europe, Canada, and other countries. The net result of these fluctuations was a decrease of only £6,333, which, while it indicates a halt, is not unsatisfactory. It should be noted, however, that



Upper Curves: Insulated Wires and Cables.
Lower Curves: Unenumerated Electrical Goods.

Fig. 3.—Other Leading Export Lines.

while the value fell, the weight of the exported machinery rose from 40,878 to 41,274 tons.

Table III sets out the figures for the past year, and it may be said at the outset that the position disclosed is by no means encouraging—a decrease in exports coupled with an increase in imports.

As will be gathered from the above brief survey of machinery exports, the decrease in the total exports for the year was almost wholly due to smaller shipments of goods and apparatus. But in the machinery section itself there were two decreases which were not quite balanced by the rise in exports of "other" motors and generators. Cables were responsible for a large part of the decrease in the total, insulated wires and cables and non-submarine cables showing together a fall of over £260,000. Batteries and accumulators also decreased by £142,653. There were only two substan-

Table III.—Exports and Imports during 1927 and 1928.

	Exports.			Imports.			Re-exports.		
	Electrical exports, 1927.	Electrical exports, 1928.	Inc. or dec. in 1928 as compared with 1927.	Electrical imports, 1927.	Electrical imports, 1928.	Inc. or dec. in 1928 as compared with 1927.	Electrical re-exports 1927.	Electrical re-exports 1928.	Inc. or dec. in 1928 as compared with 1927.
Electrical goods and apparatus (unenumerated) ...	£2,348,043	£2,542,210	+£194,167	£1,317,460	£1,495,991	+£178,531	£59,325	£87,500	+£28,175
Insulated wires and cables	3,030,157	2,868,014	— 162,143	740,221	795,785	+ 55,564	10,298	12,200	+ 1,902
Glow lamps...	593,274	532,586	— 60,688	435,370	424,968	— 10,402	15,067	10,671	— 4,396
Arc lamps and parts ...	19,464	21,041	+ 1,577	37,471	37,234	— 237	1,659	414	— 1,245
Batteries and accumulators	1,233,668	1,091,015	— 142,653	746,620	742,687	— 3,933	6,560	9,288	+ 2,728
Meters and instruments ...	374,181	378,351	+ 4,170	288,182	279,866	— 8,316	9,178	9,227	+ 49
Carbons	24,482	13,726	— 10,756	94,037	128,339	+ 34,302	580	1,456	+ 876
Switchboards (not telegraph or telephone) ...	74,524	72,857	— 1,667	1,252	1,742	+ 490	7	373	+ 366
Electrical Machinery—									
Electrical machinery (unenumerated)	3,862,032	3,784,337	— 77,695	1,598,350	1,723,422	+ 125,072	116,384	143,352	+ 26,968
Railway & tramway motors	495,159	475,191	— 19,968	—	—	—	—	—	—
Other motors and generators	2,353,626	2,444,956	+ 91,330	—	—	—	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	954,772	855,418	— 99,354	108,679	71,917	— 36,762	3,412	827	— 2,585
Submarine telegraph and telephone cable	547,998	630,301	+ 82,303	73	5,950	+ 5,877	—	—	—
Telegraph and telephone instruments and apparatus...	2,677,712	2,623,620	— 54,092	487,468	726,856	+ 239,388	42,288	35,311	— 6,977
Totals	£18,589,092	£18,333,623	—£255,469	£5,855,183	£6,434,757	+£579,574	£264,758	£310,619	+£45,861

tial rises among the "goods and apparatus" items, *viz.*, in unenumerated goods (£194,167) and submarine cables (£82,303). It should be noted that the total value of electrical exports in 1926 was £19,183,355.

In 1927 electrical imports rose in value by £907,527 above the 1926 total; last year there was a further increase of £579,574. Thus the balance in our favour (ignoring re-exports) has fallen from £14,237,418 in 1926 to £12,733,909 in 1927 and £11,898,866 in 1928.

The item which showed the greatest advance in 1928 was telegraph and telephone apparatus (£239,388), coincident with a fall in exports of this class. Unenumerated goods and machinery recorded rises of £178,531 and £125,072 respectively. The only substantial decreases occurred in the cases of non-submarine telegraph and telephone cables (£36,762) and glow lamps (£10,402).

There was a fairly general rise in the re-export section resulting in a net increase of £45,861.

The accompanying curves trace the course of imports and exports month by month.

Fig. 1 shows the monthly fluctuations of the export total during the past two years. Generally speaking, there was an improvement in the earlier part of 1928, but this was not maintained. Each curve exhibits two distinct peaks. In January, 1927, the rise of the curve was due to a large exportation of submarine cable; in November of the same year this was again a contributory cause, but a rise in exports of telegraph and telephone apparatus was mainly responsible. The two 1928 peaks—in March and November—were entirely due to greatly-increased machinery exports, which show prominently in fig. 2. In each of the two years exports reached low levels in April, July, and December; this may be attributed to holiday influences. The curves in fig. 2 illustrate the courses of two classes of exports, namely, electrical machinery and telegraph and telephone apparatus. The former class is represented by the upper pair of curves, and from these it will be seen that machinery exports are fairly steady, most of the points lying between £500,000 and £600,000. The two 1928 peaks have already been mentioned: apart from these, the influence of machinery on the general export curve is not so pronounced as might be expected when it is considered that it represents about a third of the

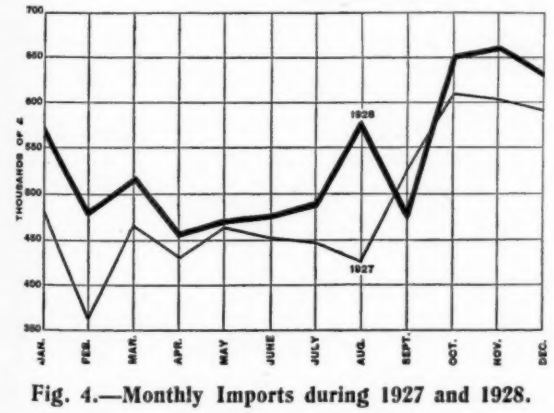
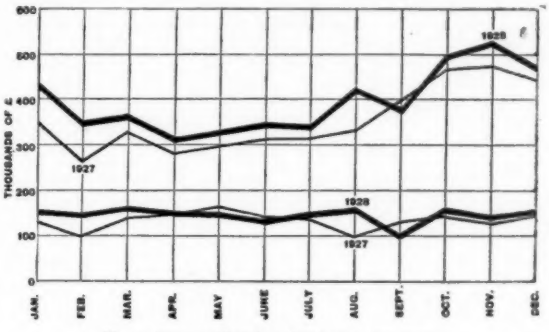


Fig. 4.—Monthly Imports during 1927 and 1928.

total. With regard to telegraph and telephone apparatus, it will be seen that for the first four months of 1928 the curve was above that for 1927, but then fell, and during the last eight months remained below it. Last year's fluctuations were far more severe than those of 1927, the difference between the lowest and highest points being £200,000, against £100,000 in 1927. Two other leading export lines are illustrated in fig. 3. In this the upper curves show the monthly exports of insulated wires and cables, including non-submarine telegraph and telephone cables. The scale is larger than that of the foregoing curves, for convenience, which somewhat exaggerates the fluctuations. During the first half of each year exports were fairly steady, but thereafter there were sudden changes. In 1927 the curve went upwards and fell at the close; in 1928 the movement was downward at first, followed by an upward trend for three months and a large fall in December. Unenumerated goods are represented by the lower curves. In comparison with other items, they show considerable steadiness. In fact, for five months of 1928 they remained at practically the same level. For most of the year they were greater in value than in the corresponding months of 1927.

Monthly import totals are the basis of the curves in fig. 4. The leading characteristic of each curve is the rising tendency throughout the year, culminating in very high values in October and November. In Novem-



Upper Curves: Electrical Goods and Apparatus.
Lower Curves: Electrical Machinery.

Fig. 5.—An Analysis of Imports.

ber, 1928, the monthly import total reached the highest figure yet recorded, and during the whole of the year (except in September) values were higher than in 1927. Fig. 4 shows that such fluctuations as occurred in the import figures were almost wholly due to electrical goods and apparatus (upper curves). Electrical machinery, shown in the lower curves, varied to a remarkably small extent from month to month. In 1928, except for a fall to just below £100,000 in September, the monthly figure never varied by more than £20,000.

Russian Possibilities.

A Moscow correspondent recently contributed an article on Russian affairs to the *Manchester Guardian Commercial* which, while containing little which was new, summarised the position very well. It was aimed particularly at showing the need which Russia has of foreign capital with which to develop her immense resources. The writer showed that while the present Government had repudiated all pre-Revolution obligations, it had always been scrupulously accurate in fulfilling its own. With regard to the magnitude of the commercial debt which Russia could safely carry, the correspondent stated that that probably depended upon the degree to which a liberal credit policy on the part of foreign business firms would hasten the development of Russian export trade up to and beyond the pre-war level and facilitate the increased production of gold and other precious metals within Russia itself. As yet there was no indication that the Soviet Union was likely to receive more credit than its natural wealth and resources would enable it to repay. After foreign trade, concessions constituted the most important commercial link between Russia and the outside world. There was an improvement in concession conditions in the latter part of 1928. The writer concluded by saying that it was questionable whether the more ambitious Soviet projects of rapid industrial expansion within the near future could be fully realised unless economic ties with the outside world, in the shape of foreign trade, concessions, and loans, were broadened and strengthened. But the Soviet Union, despite its comparative poverty, represented an inevitably expanding market for countries with highly developed machine-building industries and a potentially rich field for the daring prospector in mining and other forms of industrial pioneer development.

The Electricity Schemes.

An outline of the progress of the Central Electricity Board towards the construction of the national network of 132,000-volt main transmission lines and transformer stations.

JUST over eight years ago, in our issue of January 7th, 1921, we published an article under the heading of "The Electricity Districts," with an accompanying map showing the electricity districts as then provisionally delimited by the Electricity Commissioners for the purposes of Section 5 of the Electricity (Supply) Act, 1919. We have now prepared a map, which is reproduced herewith, showing the areas and primary transmission systems of the first five electricity schemes prepared by the Electricity Commissioners in pursuance of Section 4 of the Electricity (Supply) Act, 1926. The fifth scheme—for Mid-East England—was published only last

The numbered references relate to the tables on p. 169

Map of the Electricity Schemes.

week (see below), but the other four have been adopted by the Central Electricity Board, and work has commenced.

The first scheme—for Central Scotland—has a portion of line already erected. Contracts have been let for work in connection with the second scheme, for South-East England, and tenders have been invited in respect of the third and fourth schemes, for Central England and for North-West England and North Wales, respectively.

Some of the estimates given in the "Supplementary Particulars" published with each scheme are given below, although it is evident that the original estimates will be subject to alteration, as the Central Electricity Board has made certain modifications before adopting the schemes. The "Supplementary Particulars" state that the schemes provide for overhead primary transmission lines to be operated at a voltage of 132,000 volts between phases, the carrying capacity of each primary line covered by the estimates being not less than 50,000 kW, and that ring mains have been regarded as an essential feature in the design.

ESTIMATES FOR THE 132,000-VOLT TRANSMISSION SYSTEMS.

Scheme No.	Transmission Lines.			Transformers.	
	Circuit Miles.	Route Miles.	Cost £	Capacity KVA.	Cost £
I	256	228	661 480	810,000	903,050
II	768	511	2,100,975	1 680,000	1,867 640
III	424	369	949 921	1 235,000	1,526,370
IV	384	338	910,150	1,320,000	1,685,200
V	342	324	679 950	590,000	810,580
Total ..	2.174	1,770	5,302,476	5,635,000	6,792,830

The "Supplementary Particulars" also give the following figures for area in square miles, population, and energy sold to consumers in 1927-28:—

Scheme No.	Area in sq. miles.	Population (1921 Census).	KWH sold in 1927-1928 (millions).
I	4,980	3,761,200	730·54
II	8,828	11,392,561	1,726·01
III	7,311	5,218 146	933·95
IV	9,082	6.980,925	1,475·00
V	7,545	4.666,500	854·78
Total ...	37,746	32,019,332	5,720·28

The accompanying map, p. 168, shows the areas comprised in the five schemes which have now been formulated:—

I.—Central Scotland (ELEC. REV., May 13th, 1927, p. 754).

II.—South-East England (October 7th, 1927, p. 604).

III.—Central England (March 23rd, 1928, p. 529; revised, June 8th, 1928, p. 1020).

IV.—North-West England (June 29th, 1928, p. 1130).

V.—Mid-East England (below).

It also shows diagrammatically the layout of the 132,000-volt lines and transforming stations in connection with the above schemes (the "primary transmission system"). Several selected stations are interconnected with the primary system by transmission lines operating at lower pressures, and certain stations working under temporary arrangements are connected to the primary system by secondary lines, which are not shown on the map, but are included in the schemes. Broken lines indicate the assumed lay-out of the mains in the areas for which schemes have not been published (based on the paper by Messrs. Johnstone Wright and C. W. Marshall, read before the Institution of Electrical Engineers).

Transforming stations (132,000 volts) are to be provided (unless otherwise determined by the Board) at the undermentioned places, numbered as on the map.

CENTRAL SCOTLAND.

1 Bonnybridge. 6 Greenock. 11 Port Dundas.
2 Clydes Mill. 7 Kilmarnock. 12 Portobello.
3 Dalmarnock. 8 Kirkcaldy. 13 Saltcoats.
4 Dundee. 9 Motherwell. 14 Yoker.
5 Dunfermline. 10 Paisley.

MID-EAST ENGLAND.

15 Sheffield. 19 Hull. 23 Rotherham.
16 Valley Road. 20 Keighley. 24 Thornhill.
17 Ferrybridge. 21 Kirkstall. 25 Wakefield.
18 Grimsby. 22 Lincoln.

CENTRAL ENGLAND.

26 Avon. 33 Hylton Road. 40 Spondon.
27 Bournville. 34 Ironbridge. 41 Stafford.
28 Burton-on-T. 35 Longford. 42 Central (Stoke o/T.).
29 Derby. 36 Loughborough.
30 Freeman's M'w. 37 Nichells. 43 Stourport.
31 Hams Hall. 38 North Wilford. 44 Wolverh'pton.
32 Hardingstone. 39 Ocker Hill.

N.W. ENGLAND AND N. WALES.

45 Agecroft. 53 Kearsley. 61 Ribble.
46 Barton. 54 Kendal. 62 St. Helens.
47 Blackburn. 55 Lancaster. 63 Southport.
48 Bolton. 56 Lister Drive. 64 Stockport.
49 Carrington. 57 Nelson. 65 Warrington.
50 Chadderton. 58 Padiham. 66 Wigan.
51 Crewe. 59 Percival Lane. 67 Willowholme.
52 Hartshead. 60 Rawtenstall.

SOUTH-EAST ENGLAND.

68 Willesden (L.P. Co.). 76 South Benfleet. 85 Brimsdown.
77 Barking. 86 Maidstone.
69 Watford. 78 Kidbrooke. 87 Canterbury.
70 Luton. 79 Wimbledon. 88 Folkestone.
71 Bedford. 80 Croydon. 89 Hastings.
72 Little Barford. 81 Woking. 90 Eastbourne.
73 Peterborough. 82 Uxbridge. 91 Brighton.
74 Ipswich. 83 Reading. 92 Tunbridge W's.
75 Colchester. 84 Swanscombe.

During 1929 three more schemes will probably be published, *viz.*, covering (vi) North-East England, (vii) South-West England and South Wales, and (viii) a supplementary one for Norfolk and Suffolk (see also East Anglia, ELEC. REV., May 18th, 1928, p. 888). During 1930 the last two schemes will materialise, covering (ix) Northern Scotland, and (x) Southern Scotland.

The Mid-East England Electricity Scheme, 1928.

Prepared by the Electricity Commission in pursuance of Section 4 of the Electricity (Supply) Act, 1926.

THE Mid-East England Electricity Scheme, 1928, was published by the Central Electricity Board on January 19th. It is the fifth of its kind and deals with an area of about 7,545 square miles, covering the East and West and part of the North Ridings of Yorkshire, the Counties of Lincoln* and Rutland, and part of the Counties of Nottingham and Derby. The area had a population at the last census of approximately 4,666,500, and embraces densely populated industrial centres of coalmining, iron and steel making, textiles, and engineering; also wide tracts of agricultural territory, and includes a number of important canal, dock, and harbour undertakings.

* See also ELEC. REV., November 30th, 1928, p. 960.

At present there are 73 authorised undertakers in the area, owning between them 40 public generating stations. The consumption of electricity in 1927-28 was about 183 kWh per head of the above-mentioned population; it is estimated that this figure will increase to an average of 321 kWh in 1934-35.

According to the scheme it is proposed that 18 existing stations will be selected and operated for the Board. It is not anticipated that any new stations will be required, but the scheme provides for three further stations to be worked under temporary arrangements for a few years. There are important sources of waste heat in the area, which the Board may be able to use when the transmission system has been erected. Broadly speaking, five of the selected stations, *viz.*, Ferrybridge, Kirkstall (Leeds), Thornhill, Blackburn Meadows and

the Prince of Wales station (Rotherham), will carry the base load, while the remainder will be used for meeting the peak load; it is thought that in due course it will be possible to reduce the number of peak-load stations required.

Existing generating stations that have been selected are named in Table I, and 3-phase, 50-cycle, generating plant and boilers are to be added to the undermentioned stations:—

(i) Blackburn Meadows, 25,000 kW for the winter of 1935-36 and 25,000 kW for the winter of 1936-37.

(ii) Ferrybridge, 50,000 kW for the winter of 1935-36 and 50,000 kW for the winter of 1936-37.

(iii) Kirkstall, 50,000 kW for the winter of 1937-38 and 50,000 kW for the winter of 1939-40.

(iv) Prince of Wales, 32,000 kW for the winter of 1937-38 and 50,000 kW for the winter of 1940-41.

(v) Thornhill, 50,000 kW for the winter of 1938-39.

While the scheme is being carried to completion four municipal generating stations, *viz.*, Bridlington, Doncaster, Grimsby, and Whitehall Road (Leeds), will be operated for the Board as a temporary arrangement. There is only one company undertaking in the area.

TABLE I.—EXISTING SELECTED STATIONS.

Barnsley	(Barnsley Corporation).
Barugh, Ferrybridge, Thornhill	(Yorkshire Electric Power Co.).
Blackburn Meadows, Neepsend	(Sheffield Corporation)
Chesterfield	(Chesterfield Corporation).
Foss Islands	(York Corporation).
Halifax	(Halifax Corporation).
Harrogate	(Harrogate Corporation).
Huddersfield	(Huddersfield Corporation).
Hull	(Kingston-upon-Hull Corporation).
Keighley	(Keighley Corporation).
Kirkstall	(Leeds Corporation).
Lincoln	(Lincoln Corporation).
Prince of Wales	(Rotherham Corporation).
Valley Road	(Bradford Corporation).
Wakefield	(Wakefield Corporation).

As is indicated on the accompanying map, the stations will be interconnected by 3-phase, high-voltage, main transmission lines designed to form a series of ring mains for greater security. Incidentally, station interconnection will result in the release for revenue-earning purposes of about 80,000 kW of plant now kept as spare, representing about £1,360,000 of capital.

The principal main transmission system will comprise 324 route miles of 3-phase overhead lines and 11 transforming stations; 13 sections of line will operate at 132 kV between phases and be capable in each case of transmitting 50,000 kW, while the voltage of eight sections of line has yet to be approved by the Commission. Some 17 transforming stations will have an aggregate capacity of 725,000 kVA, the largest being at Ferrybridge (120,000 kVA), and the smallest at Lincoln (10,000 kVA).

The secondary transmission system will involve a further 20 transforming stations; six 3-phase overhead lines will operate at 33,000 volts between phases, or other approved pressure. When such lines cannot reasonably be constructed underground cables will be laid to operate at voltages to be approved by the Commission. Some 12 transforming stations will have an aggregate capacity of 41,300 kVA, the largest at Rotherham (10,000 kVA), and the smallest at Oakham (300 kVA).

As most of the undertakings in the area are efficient, it is not likely that the saving which will result from the operation of the scheme will be as great as in the case of some of the other schemes.

The cost of the scheme to the Board for the erection of the transmission system is estimated at £2,907,156, in addition to expenditure by undertakers of about £1,709,594 on extensions of certain existing stations. It is estimated that the full advantages of the scheme can be secured with a saving of about £2,148,834 on capital expenditure (up to the year 1935-36), compared with the capital expenditure that would be necessary if the present system were continued; after that date the saving on capital expenditure should be progressively greater, compared with individual development.

The Commissioners have outlined a provisional plan of working the stations, with the necessary estimates; their suggestions are, of course, tentative, since the working of the scheme, including the fixing of tariffs, is the responsibility of the Board; but, taking the figures as they stand, it is of interest to note that the Commissioners estimate that in the five years 1931 to 1936 there will be a saving to the undertakers in the area of about £1,397,360, or an average of well over a quarter of a millions pounds per annum.

The maximum load in the area at the end of 1927-28 was 372,381 kW, and is estimated to reach 624,892 kW at the end of 1934-35, an increase of about 68 per cent.; by the end of 1940-41 it is estimated to reach 923,000 kW, or 2.48 times the observed maximum load at the end of 1927-28.

The sale of electricity in the area during 1927-28 amounted to 854.78 million kWh, or an average of 183 per head of population, and is estimated to reach 1,495.87 millions in 1934-35, which represents an increase of 75 per cent. during the seven years, or an average of nearly 10.7 per cent. per annum based upon the 1927-28 output, and corresponds to a sale in 1934-35 of 321 kWh per head of population based on the 1921 census.

Between 1921-22 and 1927-28, the growth of consumption was from 405.05 to 854.78 million kWh, representing an average yearly increase of 74.95 millions, compared with the average rate of increase from 1927-28 to 1934-35 estimated at 91.58 million kWh per annum. The growing demand for electrical power in the coal mining, iron and steel, woollen, textile and other industries, and the marked increase in the demand for electricity for domestic purposes already observed in parts of the area support this estimate of increased annual growth. The sale of electricity in 1940-41 is estimated to amount to 2,277 million kWh, representing 488 per head of population based on the 1921 census.

So far as the stations of authorised undertakers are concerned, there is practically no generating plant of non-standard frequency in the area, but supplies are distributed at a non-standard frequency in a number of instances; for example, by certain authorised undertakers who derive their supplies in bulk from outside sources, such as colliery undertakings. As the alteration of these non-standard distribution systems is not essential to the carrying out of the proposed transmission

Map of Mid-East England Electricity Scheme.

system of the Board, neither the scheme nor the financial estimates make any provision on that behalf.

Copies of the scheme with map, and of the supplementary particulars with load curves, price 1s. 6d. and 3s. 6d. net, respectively, are obtainable from H.M. Stationery Office.

Water Power in the Canadian Paper Industry.

A recent analysis by the Dominion Water Power and Reclamation Service of the Department of the Interior, Canada, shows that the pulp and paper industry relies almost entirely upon water power for its energy requirements. The pulp and paper industry is Canada's greatest manufacturing industry, its gross value of production being $219,329,735. The water power utilised by the pulp and paper-mill organisations aggregates 565,362 h.p., of which 283,009 h.p. is supplied directly to pulp and paper machines, and 282,343 h.p. through electric generators. In addition, power is obtained from central stations, and the turbine capacity supplying power to pulp and paper mills in the country aggregates in round figures 1,355,000 h.p., of which 1,071,873 h.p. is hydro-electric and the remainder direct hydro drive. The power utilised in the pulp and paper industry is, therefore, over 28 per cent. of the total hydro power supply in the whole Dominion, and the power purchased in 1927 amounted to almost one-third of all the power produced for sale by the central electricity stations. The advantages of the conversion of hydraulic power to electrical energy appear both in the quality of the product, which is improved by the uniform speed obtained, and in the fact that under modern methods of transmission it is possible to develop power at sites more or less remote from centres of labour and transportation and to transmit it to points where these facilities are available for mill operation. The use of steam as a source of power for the industry is very limited, the total installation amounting to only 190,352 h.p., or 8.2 per cent. of the total power capacity. There is also some slight use of internal combustion engines.

The Overhead Lines Association.

The British climate's influence on overhead electric lines, based on actual meteorological returns.

IN a paper which he read before the Association in London on January 16th, Mr. G. W. Molle set forth the results of an examination of actual meteorological returns from 238 places, covering all parts of England, Scotland, and Wales, the investigation having been undertaken with a view to discovering what are the actual weather conditions to which British overhead electric lines are subjected. Particular attention was paid to the snowstorm which occurred in December, 1927, and the author's conclusion was that the worst to be expected is an accumulation of ice, or sleet, with a wind of less than 30 m.p.h. (probably about 10 m.p.h.), followed by a high gale, but that snow will not adhere to lines if it accompanies a high gale. The methods in use for the measurement of wind velocities were described in the paper, and such questions as low temperature conditions, the variations of temperature and wind pressure at ground and other levels, &c., were discussed.

Previous writings on the subject, said the author, showed generally that the safety factors allowed for wind pressure were much too high, and that the effect of wind on structures was usually very much over-estimated. Wind velocity was lower near the ground than at greater heights, and it was logical, therefore, to use lower safety factors for shorter poles; for instance, in the case of a pole 10 metres (33 ft.) high, most of the force of the wind acted on the top half of the pole. Gust pressure might be assumed to be twice gale pressure, but the effect of a gust was purely local. It appeared to be well established that wires of small diameter, such as those used by the Post Office, had actually been known to break under lateral wind pressure alone, but it was very doubtful if any power conductor had ever failed in that manner. Wires smaller than 0.03 sq. in. would break under wind pressure alone, but those of 0.03 sq. in. or larger would not. Figures given by Sir William Slingo (late chief engineer, Post Office) in the course of a discussion on a paper on h.p. overhead transmission lines by Mr. G. V. Twiss, before the I.E.E. in 1917, showed that wires of 0.01 sq. in. broke down in every storm, those of 0.02 sq. in. broke down in severe storms, and those of 0.03 sq. in. rarely broke down; all those wires were erected under the same conditions of assumed loading and factor of safety. Mr. Molle added that a distribution system erected very recently at Lairg, in the north of Scotland, withstood perfectly a 100-m.p.h. gale within a few weeks of completion, although many trees were uprooted. There could be no doubt that good pole-foundation work was the most important point in overhead-line construction: a good pole with a bad foundation would go over sooner or later, but a weak pole with a good foundation was far less likely to do so.

He discussed in detail the snowstorm of December, 1927, concluding that snow fell most frequently in coastal districts and highly-elevated places on the west side of the country. Snow undoubtedly fell on occasions in company with gales of velocities of from 24 to 46 m.p.h., *i.e.*, maximum pressures of from 4 to 13 lb. per sq. ft. By far the most likely condition, with snow, was a wind of 12 m.p.h., or less, just enough to keep the snow drifting and allow it to stick; hence the possible danger of a subsequent high gale. The lowest temperatures occurred always with winds of 12 m.p.h., or less. Examination of the figures as to the frequency of snow-falls over a long period showed that it was most frequent in the north and east of Scotland and England.

At heights greater than 4 ft. above ground, temperature fell an average of 1 deg. F. per 1,000 ft.; but on cold, clear, calm nights an "inversion" occurred, and the cold air fell and collected near the ground. Under those conditions a conductor which was radiating heat might reach a temperature of 10 deg. F., or lower. Summarising low-temperature data, he said that in a dead calm overhead lines might be subjected to ice loading and low temperature. With winds of from 0 to 24 miles per hour, ice, low temperature, and wind pressure might occur together, particularly with winds up to 12 m.p.h. With winds of from 31 to 46 m.p.h., snow had been known to fall, but the temperature would not be excessively low, and ice was not likely to form on wires during such a gale.

The personal experience of engineers, local officials, &c., was that snow and ice sometimes accumulated on G.P.O. lines, but not on power lines. There were two purely electrical troubles with power lines due to snow. The piling up of snow, or sleet, on the cross-arm and on tops of insulators caused a flashover which operated the circuit breaker and also removed the sleet sufficiently to allow the line to be switched in again. Where conductors were parallel in a vertical plane, the alternate accumulation and dropping of sleet caused a lower conductor to spring up and make contact with the one above.

The author's general conclusions were that gale pressures reached 18.4 lb. per sq. ft. in Western Scotland, North-West England (especially the Liverpool district), Devon, and Cornwall; momentary gust pressures reached 36 lb. per sq. ft. in those districts. In Eastern Scotland and Wales the corresponding figures were 14 and 28 lb.; elsewhere the limits were 11 and 22 lb. per sq. ft. A severe snowstorm affected the whole country: it was most unusual for snow to be accompanied by a wind greater than 12 m.p.h., equivalent to 0.43 lb. per sq. ft.; very occasionally it occurred with gales of 85 m.p.h., only one such instance having been traced by an investigation of the records from 1880 onwards. The records relating to 238 places at the time of the storm of December, 1927, showed that in only one case was there a wind of even as great a velocity as 50 m.p.h. accompanied by snow. It was safe to say that if the meteorological records of a place showed no instance of the kind up to the present date, no such trouble need be expected in that place. With a wind of 20 m.p.h. (1.2 lb. per sq. ft.) or any higher velocity, no temperature lower than 22 deg. F. need be expected. Winds of lower velocity were known to be accompanied on occasions by snow and temperatures which might be as low as 10 deg. F., depending on the local temperature records.

The new British Overhead Line Regulations prescribe a temperature of 22 deg. F., ½ in. of ice, and a 50-mile wind, but the author claimed to have shown that such conditions would never occur simultaneously where power lines of 0.03 sq. in., or over, were used. The ice loading prescribed was nothing but a simple way of expressing the mathematical idea of a wind pressure incident at some angle between the horizontal and the vertical: it was suggested that it was totally unnecessary, except in the case of wires less than 0.03 sq. in. in area, and that in the case of all other wires it would be perfectly safe to allow only for the maximum wind pressure in the district concerned, without any other load, at 30 deg. F.

Discussion.

Major THEODORE RICH said the paper brought out very clearly that it was ridiculous to apply the same regulations in, say, Middlesex and Wick, or for the Scilly Isles and the north-east of Essex. Accumulation of ice and snow upon transmission lines did not occur in this country at the same time as high winds prevailed, and it was interesting to note that the French Government in its latest regulations had given up the idea of simultaneous ice and snow loading and high wind pressure; special provision was now made for light lines in areas where such conditions were not likely to be met. At the same time, the regulations provided for very special arrangements for 120,000-volt lines where the conditions were known to be very severe. The point was that they should not be asked to pile up the capital expenditure where heavy conditions were not met with.

Mr. W. A. TURNBULL (Aylesbury) said the prevailing wind in the South of England was south-west, and he had adopted the plan of strengthening his poles where they were at right angles to it, and not worrying about the poles that were not. In the same way, he was careful to remove trees on the windward side of his lines and did not worry about the others.

Mr. W. R. ERLEBACH referred to the experience gained in connection with aircraft relative to the effect of wind pressure in relation to the form of the structure and the advantage of stream-lining. To speak, therefore, of a wind pressure of so many pounds per square foot did not convey a great deal of information unless the shape of the structure was taken into account. Mr. W. B. Woodhouse, in his recent I.E.E. paper, had drawn attention to that point, and it would be necessary to consider wind pressure in relation to the different types of overhead construction. His own observation in the Lake District showed that ice first began to form on the windward side, but as the ice needles were formed they turned with the direction of the wind. One of the Central Electricity Board's lines was to be carried through the Lake District from Cockermouth to Keswick, and it was to be anticipated that by reason of the action he had just mentioned there would be a tendency for the ice to twist the cables. The formation of ice took place at low temperature and low wind pressures at those high altitudes, but he did not suggest that the same precautions which would be necessary there should also be taken in the South of England.

Mr. W. M. MORDEY was able more or less to bear out what Mr. Erlebach had said with regard to the formation of ice

needles and what were called "ice flowers" in Switzerland. It was often stated, he added, that ice and snow would not adhere so readily to aluminium conductors as to copper conductors: he had tried to ascertain whether that was actually the case, but so far had not been able to obtain any reliable information on the point. It was claimed as a fact in the advertisements of aluminium conductors, and he had been told by the engineer in charge of the North Wales lines, that no trouble had ever been experienced with ice and snow loading those lines. If it was the fact it would be interesting to know why.

Mr. J. MULHOLLAND (Meteorological Department, Air Ministry) said the conditions favourable for low temperature were light winds and general calm, and they usually occurred during the night. The conditions favourable for the adhesion of ice were the combination of a warm westerly wind and rain falling through cold air on to a surface which was below the freezing point. In the open country the prevailing wind was between south-west and west-south-west.

Mr. C. F. MOUNSDEN suggested that there might be a streamline effect in connection with overhead-line construction which had not been sufficiently taken into account when endeavouring to ascertain the real wind pressure upon those structures; it might have to be taken into account when calculating the size of the pole.

Mr. E. K. SCOTT referred to the corona effect being less with small wires than with large ones, according to experience in the United States, and said that although they did not at present use voltages sufficiently high to make the corona effect serious, they would have to do so eventually.

The President (Mr. W. FENNELL) said it was no use the Electricity Commissioners taking a wind pressure of 50 miles an hour with ice loading into account when such conditions never existed, according to the records, in this country. Personally, he believed the ice loading would have to disappear and that some figure for the maximum wind pressure without ice would have to be worked to. He had been working in the Mid-Cheshire area for some years and had never yet experienced a 50-mile an hour wind with ice, and such conditions did not exist even in the severe storm of last year. There was any amount of wind in that part of the country, however, and he was anxious on that account; at the moment, a wind pressure of 106 miles per hour was the maximum that had been recorded, and that was getting rather close to his factor of safety. He had read some years ago in the ELECTRICAL REVIEW that somewhere in Switzerland they actually passed current through the lines to melt the snow, and, of course, that could be done by inserting a transformer and passing a heavy current at low voltage through. The idea that snow did not adhere so freely to aluminium conductors might have something to do with the fact that they heated up more than copper conductors.

Mr. G. W. MOLLE, in the course of his reply, said that when he was at Grenoble some eight years ago the French Government was then insisting upon the wind pressure and ice loading basis, but he had never been able to ascertain that those conditions had ever existed there, although many miles of aluminium lines ran over the mountains. Personally, he did not believe that they should ever meet those conditions in this country, either with aluminium, or any other type of conductors. As to the effect of the shape of the transmission structures, probably the best form would be pear shaped, but he saw no prospect of poles of that shape being adopted. He believed that in America they sent a heavy current at low voltage through the lines to melt snow and sleet.

The PRESIDENT, proposing a vote of thanks to the author, which was heartily responded to, did not agree with the view that a weak pole on a good foundation was better than a good pole on a weak foundation. Experience had shown that whereas after a storm strong poles in weak foundations shifted their positions, but could be replaced and strengthened, weak poles on strong foundations simply snapped off and cost a great deal to replace.

Load-Levelling Relays.

An attempt to show that their application in conjunction with the service fuses and simple metering installations on consumers' premises, for disconnecting load which can be dispensed with, is a solution of the load-factor improvement problem.

By W. HOLMES, A.M.I.E.E.

(*Extracts from Paper read before the* METER AND INSTRUMENT SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

IT is suggested that in future load levelling will concern the distributing mains, consumers' services, and meter engineers, rather than power-station engineers.

Metering and Tariff Methods.—No attempt is made to completely survey metering methods and tariff systems, but sufficient is said to indicate that all (except flat rates) are devised for the same object, *i.e.*, the levelling of the load on the supply mains, and considerable success has been attained, but it is becoming more and more difficult to adjust tariff rates, and it will soon be unjustifiable to exploit the lighting demand at a high price per unit when lighting no longer represents the peak load. Moreover, supply engineers must

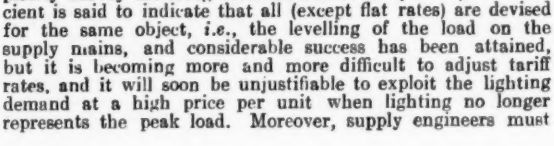


Fig. 1.—Wiring Diagram.

adopt means of levelling up the loads mechanically, or automatically, and not depend upon the consumer.

Control at Generating and Sub-stations.—One of the most interesting schemes yet put forward in a practical way is the Wilkinson change-circuit system.* Unfortunately, it needs additional mains and special gear at the receiving end. The problem of the high-voltage heating element may easily be solved, but the accurate variable-voltage meter will provide another problem.

The control of relays by pilot wires has received very little attention, but radio control of relays has often been suggested. In San Francisco there is carrier-current control of the street lighting and "Olipel" superimposed-current impulse control has already found a useful field for street lighting. The use of time switches may be regarded as control from the generating station.

Off-Peak Loads.—Before attempting to level up the load, it is necessary first to find the off-peak load. The Electricity Commissioners' Report of 1925-6 shows that, for the whole country, 51.4 per cent. of the revenue comes from lighting and domestic supplies, even if we include such large supply systems as those at Newcastle and Manchester, where the domestic load amounts to 4 and 14 per cent., respectively.

The modern electric domestic thermal-storage cylinder will retain its useful hot water more than a week after the electricity supply has been switched off: a 100-gallon storage tank on a 24-hour basis has an overall efficiency of approximately 93 per cent.: its capital cost will be of the order of £60, and its life will be over 30 years.

A secondary battery of 50-kWh storage capacity will have a watt-hour output/input efficiency approaching 80 per cent.: its cost will be of the order of £400, and its life will be under eight years.

Assuming that electricity costs ¼d. per unit, and allowing interest on the capital at 5 per cent. (simple, not compounded with depreciation), we get a total cost for *thermal storage* of 0.101d. per unit and for *electric storage* of 1.02d. per unit,† excluding battery service. Thermal storage water-heating, both for water supply and for central heating, therefore supplies the ideal off-peak load. The thermal-storage cooker is used in Norway and Sweden, chemical processes in industry might be developed, and a few illustrations of off-peak load apparatus have recently been published.‡

Load-Levelling Relays.—Intended for installation with the service fuses and meters on the consumers' premises, they will disconnect the loads which, without inconvenience to the consumer, can be dispensed with when the general demand

* ELEC. REV., January 27th, 1928.

† The battery figures are open to wide variation; it is also admitted that stored energy in the form of electricity is more valuable than in the form of heat.

‡ ELEC. REV., 1927, Vol. 101, p. 762; and 1928, Vol. 103, p. 229.

exceeds a predetermined figure; and will also connect up the loads again when the general demand is reduced, the value of the setting being decided upon by the supply engineer after the general load curve of the district has been examined. Fig. 1 is a wiring diagram, but many other methods of connection may be adopted.

Thermal, electromagnetic, and mechanical devices are utilised in the various types of relay, and a meter and load-leveller may be combined. The standard Ferranti d.c. instrument is illustrated in fig. 2: the main current passes through the heavy winding of the electromagnet E; the gasfilled mercury switch B is rigidly connected to the armature A, and as it is attracted to the core the mercury switch tilts and breaks the circuit to the off-peak load; as the operating current decreases, the switch is restored to its normal position by gravity. The magnetic gap is not completely closed, thus allowing for adjustments to be made. If the off-peak current were passed through the coil the resetting values would be much closer, but there would be danger of hunting. There are no auxiliary contacts, the only circuit to be broken being by the gasfilled mercury tube. The main-circuit coil is wound with heavy-gauge wire, having no movable contacts and a low voltage-drop. The armature is pivoted on ball bearings, and, the only moving part being the mercury switch, there is very little to get out of order. The gasfilled mercury switch used is unique in that the contacts never wear out and no fumes are given off from the arc. Switches of this type are still working satisfactorily after many thousand operations.

The relay can be adjusted within wide limits by releasing the fixing screws and sliding the electromagnet to or from the armature A. The screw R acts as a stop to keep the mercury switch level, thus the adjustments, once set, are rigid.

All these relays are designed to carry double load continuously, and they have a full-load consumption of about 1.0 volt-ampere. The 20-ampere size (40-ampere max.) has a pressure-drop of only 0.05 volt with the normal full load of 20 amperes.

The Ferranti a.c. load leveller is shown in figs. 3 and 4: the driving force is obtained from watt-hour meter elements, the current coil of which carries the current of the controlling circuit; when it reaches a predetermined value the disk armature is caused to rotate. Geared to the disk spindle through a train of wheels is a mercury switch which is caused to tilt when the disk rotates, and thus open the off-peak load circuit. When this current falls below the predetermined value the mercury switch is restored to the "closed" position by means of a spring acting against the torque of the motor meter.

To vary the current at which the load leveller is to operate, provision is made for varying the tension of the above-mentioned spring. In addition, the torque of the driving element may be varied by turning a screw which causes the current-coil core to rotate. To assist the spring to restore the switch to the closed position the meter friction-compensation device is utilised, the driving element being given a backward-shunt running tendency. If the controlling load is inductive the torque can be increased by means of the usual quadrature adjustment. The driving element has a torque of 5 gramme-cm. on the disk armature at normal full load. There is a gear ratio of 157/1 between the disk spindle and the switch arm: therefore, the torque on the switch arm would be $157 \times 5 = 785$ gramme-cm., except that it is balanced by the spring. Between the disk spindle and the staff on which the spring is mounted there is a gear ratio of 20/1, so that the torque on this staff would be 100 gramme-cm. at full load. The watt loss of the shunt coil is about 1.5, and the pressure-drop across the current or operating coil is about 0.075 volt at full load on the 20-ampere load leveller. Referring to figs. 3 and 4, A is the current or operating coil, B the shunt coil, C the mercury switch, D the train of wheels, E the spring, and F the graduated dial wheel. The adjustment is easily made by turning the graduated dial wheel.

Applications.—It is not suggested that relays will replace all other load-levelling means, but it is contended that supply engineers will find them most useful in solving many load-levelling problems.

It is necessary to level the load not only on the generating station and sub-stations, but also on the distributing mains and the consumers' premises, for most of the capital is spent on distribution and services; when domestic supplies are under consideration it is therefore more important to level up the load on the distribution and services, in order to save capital, than it is to level the load at the generating station. It may also be a problem for engineers to decide whether the combined capital charges due to load levellers and of smaller distributing mains are not less than the extra running cost of partly loaded generators. By adding a load leveller the capital cost may be reduced from a 40-ampere service to a 25-ampere service. This may be done—and is done fairly successfully—by means of a time switch, but the load leveller is effective where the time switch does not always do the correct thing; that is, the time switch operates at the time it is set to operate, while the load leveller operates with the load.

The two-way and multiple-way switch may be used for load-levelling, or else the pilot plug, or the key switch. While the two-way switch has a great attraction from the point of view of cheapness, it is doubtful whether the inconvenience caused does not in time prevent electrical developments. To trust to the human element to replace the position of the switch might lead to considerable inconvenience; for instance, the water-heating load might be accidentally left off.

The introduction of another instrument in the form of a load leveller will further complicate the supply service as at present installed, but if it replaces some of the very complicated metering methods used it will be a further step towards standardisation and reduced costs. With the perfect system of load-levelling, the two-part tariff system would become a one-part tariff. It would be possible to go back to the fixed charge per year, or to use demand indicators as a basis, but the integrating watt-hour house-service meter is now so reliable and so cheap that it will hold its own for very many years to come.

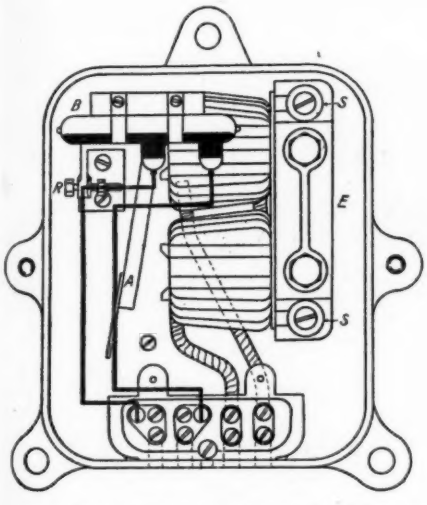
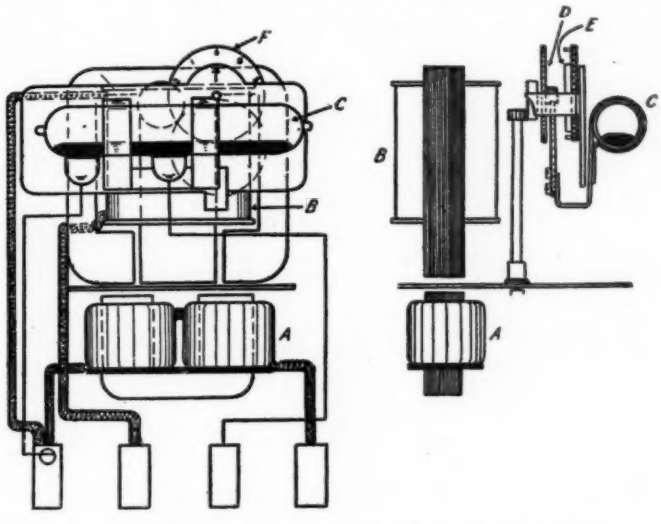


Fig. 2.—Ferranti D.C. Load-leveller.



Figs. 3 and 4.—Ferranti A.C. Load-leveller.

B.E.S.A. Publication.

The British Engineering Standards Association has recently issued revised B.S.S. for three qualities of brass sheet and strip which supersede the specifications first issued in 1926. The numbers of the specifications and the grades covered are as follows: No. 265-1928, 61/39, brass sheet and strip; No. 266-1928, 65/35, brass sheet and strip; and No. 267-1928, soft cartridge brass sheet and strip. The principal modifications which have been made to the specifications are the addition of tolerances on the thicknesses of wide sheets, the revision of certain of the requirements connected with the measurement of these tolerances, the mechanical tests and the tests for hardness and ductility. Copies of the revised specifications may be obtained from the Publications Department of the British Engineering Standards Association, 28, Victoria Street, Westminster, S.W.1, price 2s. 2d. each, post free.

The Physical Society's Exhibition.—II.

Annual Display of Electrical Instruments and Scientific Apparatus.

British Metallising Co., Ltd.

The exhibit was intended to illustrate present and possible uses to scientific instrument manufacturers of the company's process of producing a metal film, or coating, firmly adherent to a non-metallic base on which, in turn, a large range of non-ferrous metals may subsequently be plated to any desired thickness. Rubber, in many forms, cellulose acetate compounds, wood, &c., are all suitable bases on which silver, gold, copper, nickel, or lead, can be deposited by this interesting process, which depends on a chemical base reaction between the metallising substances and the non-metallic base, as the result of which integration is obtained. The metal surfaces of copper of two commutators of the Fleming type, perfectly uniform, with an excellent polished surface, formed continuous contact pieces on the vulcanite block; the advantages of this method of commutator construction, which eliminates the use of any joins, are obvious. In the case of wireless panels (copper on vulcanite) the whole of the contact surfaces are absolutely rigid without soldered joins or screw connections; a panel or distribution board of this type will stand heavy wear, and is not affected in any way by vibration. Switch plates (copper on cellulose acetate compound) may conveniently be made in any colour, transparent, translucent or opaque, and may be inlaid or easily ornamented with any desired design.

Marconi's Wireless Telegraph Co., Ltd.

In addition to complete naval, military, and aircraft telegraph and telephone receivers and transmitters, the exhibit included the latest type of direction finder, Type 11G, for merchant ships shown in fig. 1; it is used in conjunction with a fixed frame aerial, and possesses a screened valve amplifier and a radio goniometer provided with two scales for reading bearings relative to the ship's head and true bearings, covering a wave-range of from 400 to 1,100 metres.

An instrument of utility to authorities allocating transmitting licences, research workers, and those responsible for commercial wireless stations is the signal-strength measuring set shown in fig. 2. A frame aerial for the reception of the desired signals is mounted on a coupling unit which also contains a means of attenuating the signals produced by a local oscillator, which is capable of being tuned from 14 to 5,000 metres, and is coupled to the frame and to a receiver. By means of the attenuator the signal strength of the local oscillator can be measured and made equal to the received signal. The signals can be equalised by ear or, in the case of rapidly varying signals such as occur in the short-wave

Fig. 1.—Marine Radio Direction Finder.

band, the receiver output can be calibrated on a recording device. The local oscillator output is adjusted to be of exactly the same frequency as the signals to be measured, and the current is measured by a thermomilliammeter. The receiver is a frame, and the set will therefore measure primarily the magnetic field in the wave at the point considered, and the audio intensity of the signal produced is measured by comparison with the known signal strength of the local oscillator. The attenuator and coupling unit, the local oscillation generator, and the battery box are each contained in a heavy metal shielding case, which completely screens them from external interference.

The successful transmission of wireless messages in facsimile has necessitated the development of a means of controlling with extreme accuracy the transmitter and receiver. In the system developed for use on the Marconi beam circuits, speed control is secured by supplying a synchronous motor with current from an electrically-maintained tuning fork which is kept at constant temperature by a thermostat. The tuning fork is made of mild steel with low damping, and it is maintained in continuous vibration by reaction; the whole fork and mounting is placed in a heat-insulating box, and maintained at a set temperature (above that of the room in which the apparatus is used) by means of a toluol regulator, which closes a contact when the temperature reaches a certain pre-

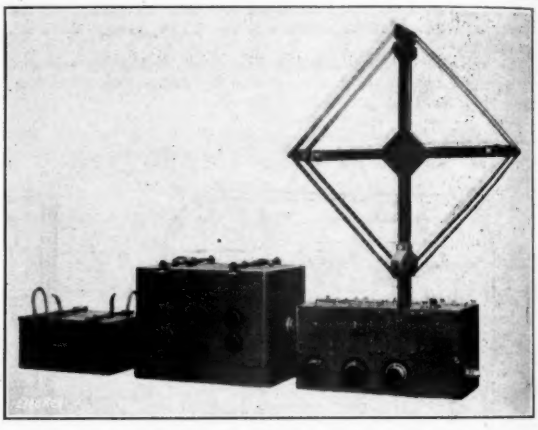


Fig. 2.—Radio Signal-strength Measuring Set.

determined value and by means of a relay switches off the heater lamps in the chamber. As soon as the temperature falls the contact opens and the lamps are switched on, and two fans at the top of the box maintain the air in the chamber in constant circulation to avoid any temperature gradient; thus the temperature of the fork is maintained constant to within about 0.1 deg. F. The weak alternating current from the tuning fork circuit is amplified by a bank of valves, the anode current of which passes through the armature winding of the synchronous motor in the driving machine, thus maintaining it in synchronism with the frequency of the tuning fork, or with that of some selected multiple.

H. W. Sullivan, Ltd.

The modern ultimate standard of radio-frequencies is a valve-maintained turning fork having a frequency adjusted very exactly at 1,000 per second. One of them was exhibited and its N.P.L. certificate indicated that its frequency was 1000.000 and its temperature coefficient $\pm 0.00_{0}$ cycles per second per degree Centigrade, a truly remarkable fork. With it was exhibited the special phonic wheel (fig. 3) by which the fork frequency can be standardised directly against that of a standard clock. The wheel itself is valve driven; it quickly attains to a high speed with two of its electro-magnets connected to the input and output of a three-valve amplifier. When synchronous speed is reached a small output e.m.f. is taken from the fork being standardised, amplified by another three-valve amplifier, and applied to an additional driving magnet of the wheel, which then runs smoothly as a pure synchronous motor at the frequency of the fork. A contact, operated by the wheel, impulses the pen of a chronograph once every second, the same chronograph record being marked electro-magnetically in exact seconds from a standard clock. Thus the frequencies of clock and fork can be compared within one part in 100,000 with a run of 1,000 seconds' duration.

Substandard wavemeter components of great precision included the Sullivan-Griffiths precision variable air condenser, the original design of which was exhibited last year, when a very marked improvement in overall calibration accuracy was claimed due to the fact that adjacent dielectric air gaps were arranged to be electrically in series and complementary. A series-gap condenser employing a solid metal moving plate, although eliminating capacity errors due to moving system displacement in a direction purely normal to the plane of the fixed-plate surfaces, only partially corrects for plate tilting and uneven rotation. In order to overcome these possible causes of capacity change a new form of moving plate has been de-

signed in the form of a thick glass plate well proportioned for strength, thoroughly silvered and then copper plated. The metal coating is then sub-divided into a number of insulated "islands" coincident on the two surfaces of the plate. Perfect continuity of plating is arranged between coincident pairs of "metallic islands," either over the outer edges of the plate, or through holes arranged so as not to affect the "law" of capacity variation (fig. 4). If c_1 and c_2 are the capacities from two coincident islands on the upper and lower surfaces of a moving plate, respectively, to adjacent and oppositely connected fixed plates, and c_3 and c_4 are the similar capacities from an adjacent coincident pair of islands: then $c_1 c_2/c_1+c_2$ will be constant irrespective of changes of position of the moving plate in the gap between adjacent fixed plates. Similarly, $c_3 c_4/c_3+c_4$ will remain constant, and, in addition, $(c_1 c_2/c_1+c_2)+(c_3 c_4/c_3+c_4)$ will also remain constant, irrespective of any relation between c_1 and c_3 or between c_2 and c_4.

For association with this condenser, Mr. W. H. F. Griffiths has also designed standard inductances which are extremely constant in value. The temperature coefficient is rendered negligible without increasing the losses of the coil by constructing the various members of the former of insulating materials having different linear expansion coefficients and phase angles, which results in a compensation effect due to unequal thermal expansion in diametrical and axial dimensions without the introduction of material of high power factor in the field between adjacent turns of the winding.

The new Lucas frequency standard is a quartz resonator of extremely constant frequency, due to the patented method of crystal mounting at nodal zones of vibration and in an evacuated vessel (fig. 5), so that stability of

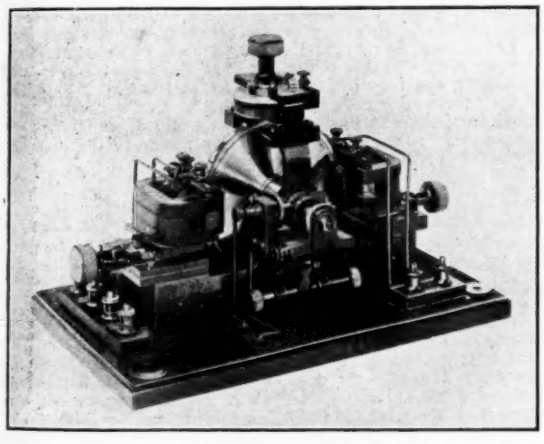


Fig. 3.—Phonic Wheel.

frequency is ensured to within a few parts in a million, and the temperature coefficient is of the same low order.

An exhibit of outstanding importance amongst the audio-frequency alternating-current measuring apparatus was an

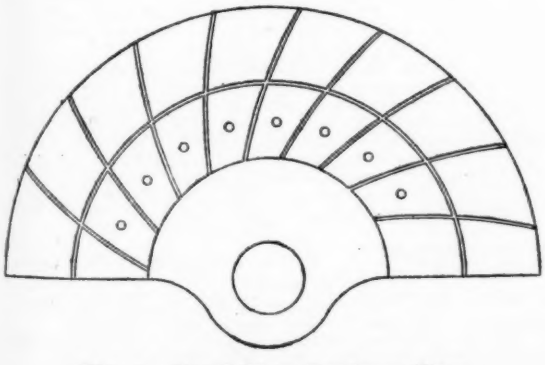


Fig. 4.—Novel Glass Condenser Vane.

adjustable mica condenser having a total capacity of 1 μF, subdivisable in steps of 0.001 μF. The constancy and temperature coefficient of this new condenser have been reduced to such low limits (1 part in 100,000 per deg. F.) that it has been *brought within the category of precision instruments.*

Fig. 5.—Quartz Frequency Standard.

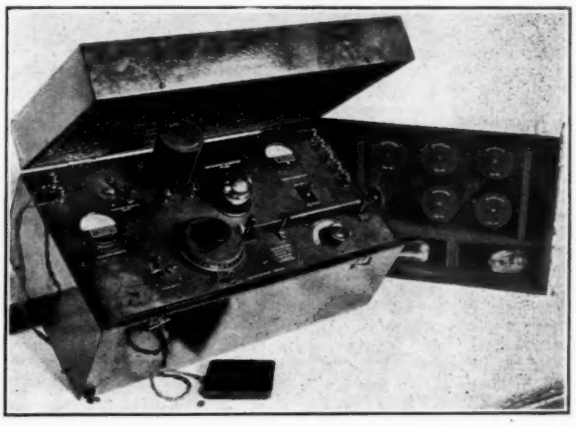


Fig. 6.—Short-wave Heterodyne Wave-meter.

M.O. Valve Co., Ltd.

As its name implies, this company makes Marconi and "Osram" radio valves, and also demonstrated how h.f. current generated by valves can be used for widely different purposes. A portable trolley housing two large oscillating valves generating h.f. current, similar to apparatus used in pumping operations at the valve works, was used to light metal-filament lamps and to boil water by heating inductively a metallic loop immersed in the liquid. A method of displaying the technique of cooled-anode-valve manufacture consisted of a complete oscillating circuit with two miniature cooled-anode valves in parallel, fed with a.c. from the mains through the usual transformers, the anodes being at a potential of approximately 5,000 volts r.m.s. and dissipating approximately 400 watts. The valves (of course, non-standard) were fitted with small jackets and were water-cooled in close imitation of their larger brethren. The high-frequency output of them was used to energise four neon-filled "Osglim" letter lamps, and such lamps placed in the vicinity of the exhibit lit up spontaneously. A machine was shown making valve filament supports entirely automatically; nickel wire from a reel was fed into the machine, which drops down a chute the necessary supports, cut to the correct length, with one end flattened and bent over. A new range of dull-emitter transmitting and modulating valves represented advance in characteristic goodness, coupled with economy in filament consumption; their approximate electrical characteristics are given below:—

	DETI. SW	DET. 2.	DEM. 3.	DEM. 3.
Filament voltage ...	6.0	12.5	15.0	15.0
Filament current ...	2.0	3.0	4.0	4.0
Amplification	8.5	16.0	5.5	16.0
Impedance	5,000	4,000	1,250	3,000
Anode voltage ...	1,000 max.			

An educative demonstration had also been arranged with a view to showing how the dimming of a rectifying-valve filament may lead to serious over-heating of the anode, with consequent loss of filament emission, due to the increased impedance of the valve, which gives rise to a larger voltage drop across the rectifier, causing the anode to dissipate a much higher wattage than the normal.

Correspondence.

Correspondents should forward their communications as early as possible. No letter can be published unless we have the writer's name and address in our possession.

The Salaries of Technically-trained Engineers.

From time to time I have initiated correspondence on the above subject. On the whole, the responses have been meagre, and have given little indication that support would be forthcoming for any scheme of action. Recently, however, although little has been suggested in the way of remedial measures, there appears to be an awakening realisation among electrical engineers that their remuneration is not only unsatisfactory, but is also likely to remain so. To me it is becoming increasingly clear that, despite optimistic views as regards trade generally, there is no room for optimism as regards the position of individual engineers. In fact, it seems impossible to believe that, under present conditions, their position can improve. If this fact could only be brought home to those who are hanging on to a precarious livelihood in the hope of better days coming, and to those who, just deciding on a career,

believe that there is always a vacant twig awaiting their occupancy at the top of the electrical tree, something might be done. It appears to me that the realisation is sufficiently awake to make this time an auspicious one for launching a new Society of Engineers, the one primary object of which would be to take all the necessary steps to improve the salaries of engineers—chiefly technical engineers—and ensure the possibility of their being able to contemplate spending their declining years outside the workhouse—which, in all seriousness, is the prospective destination of large numbers of engineers at the present moment.

To my mind, the fact of the formation of such a society would, in itself, have beneficial results. It would require a full-time secretary and a small staff at the commencement, and, before launching it, a membership of 800 to 1,000 would have to be assured. I would suggest an annual subscription of £1, and an entrance fee of £1, the latter being remitted in the cases of the first 500 members.

Whilst the work of such a society would naturally develop as necessity demanded, I suggest that its first useful work would be to enlighten the general public, through the medium of the daily Press, as to the prospects of recruits to the engineering industry.

Much more could be written, but it is time for action. I therefore invite all engineers who would be prepared to support some such scheme to send me their names, addresses, occupation, and length of experience. They will be regarded in the strictest confidence. Should a sufficient number respond, I will ask a few of these living in my part of the country to discuss lines of development.

Organise.

January 16th, 1928.

[The Society of Technical Engineers, formed ten years ago with the same purpose as one of its objects, is still in existence; has our correspondent taken this into account?—EDS. ELEC. REV.]

Bottom or Side Heat?

With trepidation, as befits one of the much-maligned corps of electric cooker designers, I would submit an opinion in favour of side and bottom heating for ovens, as recommended by "A Station Engineer" in your issue of the 28th ult.

Manufacturers are mostly awake to the relative advantages of the various systems of oven heating, and in our own case side and bottom heating was adopted only after extensive tests and extended experience, and despite the fact that it is more costly in production than the alternative top and bottom method.

The obvious ideal for which we all strive is perfectly even heating throughout the oven, irrespective of how much or how little food is placed in the oven; but in a well-filled oven this can never be attained by a system that provides no circulation of heated air and merely distributes the heat in stratified formation.

The loading of the oven with food presents, in fact, the greatest difficulty. The baking of a single cake or joint provides no test, but when the oven is filled to capacity, then it is that some system is required that will overcome the retarding effect on circulation. Neither bottom nor bottom and top heat can of themselves overcome this retardation, which will always be present whilst kitchens (and cooking space) continue to decrease in size and the occupiers' appetites remain the same.

Side heating, if the elements are placed behind roomy shields, promotes a good circulation of air despite any load that may be introduced into the oven.

This system alone, however, produces a cool zone at the base of the oven, which we overcome by the introduction of bottom heat. As "A Station Engineer" suggests, this should not be skimped, since circulation induced by the side elements will ensure the even distribution of this heat.

The result of this system is an ideal circulation under all conditions and top heat is *not* required.

Your correspondent, Mrs. Annie Mole, is undoubtedly a splendid cook, but her expressed opinion in the matter must be influenced by her commendable and natural loyalty to her latest *protégé*.

I was privileged to hear Mr. Ellerd-Styles discourse before the I.E.E. on the subject of "Large Electric Baking Ovens," concerning which subject he is undoubtedly well versed, but I feel that he has yet something to learn before he can speak authoritatively on the design of domestic cookers.

The factors of space and production cost are of some importance where cookers are required for hiring at low rentals to small houses. Also the lagging of an oven, which is required to cook meat satisfactorily, may be overdone, so that too long a time must elapse before the temperature at which the meat is "sealed" drops to the temperature at which the meat should be cooked.

In conclusion, may I say that your desire for agreement and uniformity on this vexed question is one which all manufacturers will echo, but the research you suggest should, we think, be conducted by some unbiased body, preferably of cooks.

S. F. Bickell,
Chartered Electrical Engineer,
REVO ELECTRIC CO., LTD.

Tipton, *January 14th*, 1929.

Legal.

Landau v. Wholesale Fittings Co., Ltd.

IN the King's Bench Division, on January 16th, before Mr. Justice Swift and a common jury, Mr. Solomon Landau, electrical engineer, Commercial Road, E., sued the Wholesale Fittings Co., Ltd., Commercial Street.. E., for damages for personal injuries sustained through falling down a stairway at defendants' premises, which he alleged was due to a defective step.

Plaintiff said that after visiting defendants' showrooms he went to the inquiry office for a catalogue, and, as he was coming down the stairway, his right foot caught in a protruding piece of a brass strip which covered the edge of the top step, and he fell to the bottom of the stairs, injuring his ankle. He claimed £96, loss of earnings, in addition to other damages.

Mr. ROWLAND THOMAS, for the defendants, said that the step was perfect, and there was no concealed danger which caused plaintiff's accident and for which defendants were liable.

The jury returned a verdict for the defendants, and his Lordship entered judgment accordingly, with costs.

Marconi's Wireless Telegraph Co., Ltd., v. Attalx, Ltd.

THIS action came before Mr. Justice Astbury, in the Chancery Division, on January 22nd, on a motion by plaintiffs for judgment in default of defence.

Mr. TREVOR WATSON, for the plaintiffs, said the action was brought for an account of certain royalties due under an agreement, an injunction to restrain breach of the agreement, and damages. The defendants had entered an appearance in the action, but had not put in a defence. It was alleged that defendants had sold wireless receiving sets and battery eliminators which infringed plaintiffs' patents. In the agreement entered into defendants acknowledged their liability to pay to the plaintiffs a royalty of 12s. 6d. per valve holder upon all receiving sets, and a royalty of 12s. 6d. on each battery eliminator employing any of the plaintiffs' patents and sold by defendants from April, 1925, to the date of the agreement. The defendants further undertook to render a complete royalty statement, but they had not done so, and had only paid £50 of the amount due under the agreement. Counsel accordingly asked for judgment against defendants and an inquiry as to the damages sustained by plaintiffs by reason of the breaches of the undertaking.

His LORDSHIP gave judgment as asked.

Electroservice, Ltd., v. Northern Wholesale Electric Supply Co.

IN the Southwark County Court, on January 17th, before Judge Moore, Electroservice, Ltd., Waterloo Road, S.E., electrical accessory suppliers, sued the Northern Wholesale Electric Supply Co., electrical importers, Holloway Road, N., to recover £56 2s. for electric heaters supplied.

Mr. EDRIC PHILCOX, for the plaintiffs, said the claim was for what were called "double-ray" heaters. The defendant ordered 1,099 at 5s. 6d. each, and the first agreement was that they should be delivered in three equal consignments, and payment should be made by a three months' bill. Later, at the defendants' request, other terms were arranged, as they only wanted to take small quantities at a time, and asked that a one-month post-dated cheque should be accepted, after the delivery of each lot. This was finally agreed to by the plaintiffs, and, in all, some 366 had been delivered, but the last three consignments, valued at £27 10s., £19 16s., and £8 16s., had not been paid for. In the first case a cheque was given, but the defendants stopped it, but no cheque was given for the other two deliveries.

Mr. A. L. HOLDING, plaintiffs' managing director, said that he previously carried on business as the British Patents and Imports, but he later formed a limited company in the name in which he was suing. The defendants were notified of the change, and thereafter defendants addressed them by the new name. No complaint was made as to the heaters until the action was started, although he had changed a few heaters, as they proved to be defective.

Mr. J. J. MERCER, partner in the defendant firm, asked for an adjournment as his solicitor was unable to attend, and he had all the papers concerning the action. His Honour granted the defendants' application.

English Electric Co., Ltd., v. Crompton Parkinson, Ltd.

IN the Chancery Division last week Mr. Kenneth Swan moved before Mr. Justice Eve for judgment in this action.

Mr. TREVOR WATSON said he opposed the plaintiffs getting the costs of the action. After what the defendants offered the action ought not to have been brought.

Mr. SWAN said the action was for infringement of copyright in three photographs of electrical machinery of the plaintiffs' construction and design. Blocks or negatives of these photographs came into defendants' possession, and they used the photographs for advertising their own goods, by publishing them in electrical journals. The defendants were communi-

cated with as soon as the advertisements came to the notice of the plaintiffs, and defendants offered an undertaking with which the plaintiffs were not satisfied. It was simply to be given in a letter, and plaintiffs considered they were entitled to an order, and they went to court, and a motion for an interlocutory injunction was moved. Plaintiffs intimated that they were willing to treat the motion as the trial of the action, but Mr. Watson refused to make an end of the matter, and an undertaking was given in terms of the notice of motion, and the costs were reserved. Plaintiffs delivered their statement of claim and defendants their defence, admitting everything alleged in the statement of claim, and setting forth the offer of an undertaking prior to action, and that the proceedings should not have been initiated. In Mr. Swan's opinion the action which plaintiffs took was wholly justified.

Mr. WATSON said plaintiffs did not object to the offer on the footing that they wanted it taken in Court. Their objection to the offer was that they wanted an apology as well, to be given the same publicity as the defendants' advertisement. To that the plaintiffs were not entitled. Defendants were not prepared to allow themselves to be trampled in the dust by the plaintiffs. Neither ought they to be mulcted in the costs incurred after the motion.

Mr. Justice EVE thought the plaintiffs were entitled to their costs of the action, including the reserved costs of the motion. Negotiations having broken down, the plaintiffs were undoubtedly entitled to commence the action. It was much to be regretted that anything took place on the hearing of the motion which resulted in the defendants feeling that they could not, consistently with the attitude they had hitherto taken up, submit to pay the costs. The plaintiffs had to proceed with the action, and he could not see any reason for depriving them of the costs, including the costs reserved.

Charge of Stealing Electricity.

AT the Maldon (Essex) Borough Petty Sessions, on January 15th, Joseph Rudge, electrician, was charged with, between December 10th, 1928, and January 7th, 1929, fraudulently abstracting electricity, the property of the Maldon and District Electricity Supply Co., and feloniously consuming it. Defendant pleaded guilty. For the company it was stated that their representatives, when examining the shilling-in-the-slot meter on December 10th, found eleven shillings in the meter, which did not represent the electricity consumed. It was subsequently discovered that electricity consumed between the emptying of the meter on December 10th and January 7th had not been paid for, the connections having been tampered with. The charge was not pressed, as defendant was understood to be in bad circumstances; it was brought to show people that they must not tamper with their electricity supply. The Mayor commented upon the seriousness of the offence and the severe punishment that might follow it, but said that as the prosecutors did not press the charge the Bench would take a lenient course and bind defendant over in the sum of £5 for one year. He must, however, pay 30s. to the company for the electricity consumed.

Cable Makers' Association v. City Engineers' Supply Co.

A MOTION by the Cable Makers' Association against the City Engineers' Supply Co. was mentioned to Mr. Justice Eve in the Chancery Division on January 18th.

Mr. D. H. CORSELLIS for the plaintiffs said that it was a motion to restrain infringement of three registered trade marks. Defendants were prepared to treat the motion as the trial of the action and to consent to a perpetual injunction, an order for delivery up or destruction of the infringing articles, and to pay the plaintiffs' costs. There would be no order as to damages.

Counsel for the defendants agreed to this course.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1927.

16,770. "Electric annealing-furnaces of the resistance type." Akt. Ges. Brown, Boveri et Cie. June 23rd, 1926. (273,920.)

16,963. "Motor vehicle and other lamps." J. Lucas, Ltd., O. Lucas and W. H. Egginton. June 25th, 1927. (303,033.)

17,437. "Motor vehicle and other lamps." J. Lucas, Ltd., O. Lucas and W. H. Egginton. June 30th, 1927. (303,185.)

22,033. "Electrical time-switch mechanism applicable particularly to moulding and vulcanising apparatus." Dunlop Rubber Co., Ltd., H. Willshaw, W. A. Davis and H. Smith. August 22nd, 1927. (303,075.)

22,512. "Thermionic valves." W. S. Smith and N. McLachlan. August 26th, 1927. (303,037.)

22,575. "Electric incandescent lampholders." A. E. Spencer, P. H. Waller and General Engineering Development Trust, Ltd. August 27th, 1927. (303,039.

22,901. "Illuminated signs." J. R. Quain. August 31st, 1927. (303,190.)

24,736. "Direction indicators for motor vehicles and the like." H. H. Holland. July 19th, 1928. (303,212.)

24,979. "Electric cut-outs." J. Grossart. September 22nd, 1927. (302,960.)

25,010. "Electric device for driving the windshield-wipers of motor road vehicles." S. & U. Holding Co., Inc. September 30th, 1926. (278,350.)

25,061. "Telephone systems." Associated Telephone and Telegraph Co. September 22nd, 1926. (277,988.)

25,108. "Electric current-interrupters." C. E. Bennett. September 23rd, 1926. (277,990.)

25,118. "Protection of dynamo-electric machines." British Thomson-Houston Co., Ltd., P. H. Harding and J. M. Goodall. September 23rd, 1927. (302,973.)

25,125. "Starting and operating luminous discharge tubes." Rainbow Light, Inc. June 9th, 1927. (283,681.)

25,126. "Luminous electric discharge tubes of high candle-power." Rainbow Light, Inc. July 9th, 1927. (293,682.)

25,127 "Argon mercury discharge tubes." Rainbow Light, Inc. July 9th, 1927. (293,683.)

25,142. "Thermionic valves." H. J. Round. September 23rd, 1927. (303,082.)

25,183. "Transformers for high-frequency electric circuits." Radio Instruments, Ltd., and G. W. Hale. September 23rd, 1927. (302,976.)

25,231. "Track signaling systems for railways and the like." L. H. Peter and Westinghouse Brake & Saxby Signal Co., Ltd. September 24th, 1927. (302,979.)

25,350. "Control of electrically-operated switches." British Thomson-Houston Co., Ltd., and H. C. Hastings. September 26th, 1927. (Addition to 233,438.) (303,040.)

25,421. "Reception and recording of electrical signals over cables or the like." S. T. Gaskin. September 27th, 1926. (278,014.)

25,423. "Electromagnetic devices operated by alternating or oscillatory currents." J. Hoffmann. September 25th, 1927. (303,085.)

25,469. "Balanced electric protective systems." A. Reyrolle & Co., Ltd., and H. C. Atkins. September 27th, 1927. (303,047.)

25,472. "Electric motors." British Thomson-Houston Co., Ltd., and H. Dreghorn. September 27th, 1927. (303,048.)

25,474. "Luminous signs." C. J. Coleman. September 27th, 1927. (Cognate application 30,306/27.) (303,049.)

25,499 "Electric circuit-breakers or switches." A. Reyrolle & Co., Ltd., J. Mirrey and A. Allan. September 27th, 1927. (303,051.)

25,508. "Automatic or semi-automatic telephone systems." S. G. S. Dicker (Associated Telephone and Telegraph Co.). September 27th, 1927. (303,086.)

25,509. "Telephone systems." Associated Telephone and Telegraph Co. October 18th, 1926. (279,058.)

25,585. "Electric fusible cut-outs." A. Reyrolle Co., Ltd., R. H. Brierly, Yorkshire Switchgear and Eng. Co., Ltd., W. H. Isherwood and R. T. Norton. September 28th, 1927. (Addition to 267,593.) (303,090.)

25,718. "Means for interlocking doors or lids of chambers or boxes applicable for enclosing electric switchgear and other apparatus." English Electric Co., Ltd., A. M. Pooley and A. A. Heath. September 29th, 1927. (303,195.)

26,014. "Electro-deposition of rubber." S. O. Cowper-Coles. October 3rd, 1927. (303,214.)

26,613. "Remote-control of electric-power sub-stations." Associated Telephone and Telegraph Co. October 11th, 1926. (278,746.)

26,677. "Electric protective arrangements." British Thomson-Houston Co., Ltd., J. G. Weilings and C. G. Mayo. October 8th, 1927. (Cognate application to 227,910.) (303,221.)

26,755. "Electric furnaces for heat treatment and forging." A. Imbery. October 10th, 1927. (303,222.)

27,259. "Electric junction-box and switch." J. Bathgate. October 14th, 1927. (303,225.)

29,495. "Electric circuit-breakers." W. H. Illingworth and B. Bell. November 4th, 1927. (303,242.)

30,675. "Shade-supporting arrangements for electric lamps." Siemens Electric Lamps & Supplies, Ltd., and R. Sivyer. November 15th, 1927. (303,247.)

31,022. "Process for the manufacture of cathodes for electric discharge tubes." Vereinigte Glühlampen und Elektricitats Akt. Ges. April 30th, 1927. (289,702.)

32,091. "Thermo-electrically-operated devices for the protection of rotary machines." Electrical Improvements, Ltd., and H. B. Poynder. November 29th, 1927. (303,253.)

32,589. "Methods of and apparatus for starting squirrel-cage motors." F. Smith. December 2nd, 1927. (303,259.)

33,567. "Electric furnaces." British Thomson-Houston Co., Ltd. December 29th, 1926. (282,741.)

34,476. "Junction working between exchanges in telephone systems comprising automatic exchanges." Relay Automatic Telephone Co., Ltd., B. B. Johnson and T. M. Luman. December 30th, 1927. (303,267.)

1928.

7,562. "Electric cooking or heating appliance with time-switch device." K. Armin. March 12th, 1928. (303,301.)

7,862. "Electric lighting system." A. E. Spencer, P. H. Waller and General Engineering Development Trust, Ltd. August 27th, 1927. (Divided application on 303,039.) (303,053.)

9,375. "Ignition magnetos for internal-combustion engines." M. M. Cardellino. March 28th, 1928 (Addition to 269,374.) (303,310.)

9,727. "Safety device for overhead contact-arms, as applied to tramcars, railless electric cars, and the like." H. Covill and R. Suffling. March 30th, 1928. (303,312.)

11,228. "Electric battery containers." A. E. White (T. R. Palmer). April 16th, 1928. (303,341.)

11,883. "Electrical transformers." G. W. Johnson (Naamlooze Vennootschap W. Smit en Co's Transformatorenfabriek). April 23rd, 1928. (303,320.)

12,795. "Electric signal and control systems." British Thomson-Houston Co. Ltd. June 29th, 1927. (292,993.)

14,175. "Submarine cables." Felten & Guilleaume Carlswerk Akt. Ges. October 31st, 1927. (Addition to 295,923.) (299,762.)

18,399. "Insulating material for electric condensers and the like." J. E. G. Lahousse. August 1st, 1927. (Addition to 275,958.) (294,931.)

20,010. "Knee-control mechanisms for electric sewing-machine cabinets." W. Fairweather (Singer Manufacturing Co.). July 10th, 1928. (303,337.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from January 16th:—

Jill Frost. No. 496,421. Class 6. Refrigerating machines.—Electrolux, Ltd., 153-155, Regent Street, W.1.

Lissen. No. 493,682. Class 8. Radio-telephonic and telegraphic apparatus and parts thereof.—Lissen Ltd., Friar's Lane, Richmond, Surrey.

Electramonic (lettering and design). No. 492,387. Class 8. Radio-telephonic instruments, &c.—Electramonic Co., Ltd., Bear Gardens, Park Street, Southwark, S.E.1.

Givrite. No. 493,934. Class 8. Electrical resistances, high-voltage cut-outs, rheostats and similar electrical apparatus for use in high-pressure electrical installations, and radio-telephonic and telegraphic apparatus and parts thereof.—La Société Le Carbone, Gennevilliers (Seine), France. (British representatives: D. Young & Co., 11-12, Southampton Buildings, Chancery Lane, W.C.2.)

Apiezon. No. 497,537. All goods in Class 47.—Metropolitan-Vickers Electrical Co., Ltd., Central Buildings, Westminster, S.W.1.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

BARNET.—Extensions, girls' grammar school (£15,472), for Herts. E.C.; county surveyor, Hatfield.

BARNSLEY.—Technical college, for the borough E.C.; Briggs & Thornley, architects.

BARWICK.—Elementary school (£7,000); West Riding Education Committee.

BEDFORD.—Stores, for Igranic Electric Co., Elscow Road; I. Daughtry. Welfare centre, Priory Street; borough engineer.

BIRKENHEAD.—Rehousing scheme; Mersey Tunnel Joint Committee. Gas offices and workshops (£17,000); J. A. Milestone & Son, Wallasey, and H. Brocklesby, Birkenhead.

BLYTH.—86 houses, Second and Eighth Avenues, by direct labour; borough engineer.

BOURNEMOUTH.—Town hall extensions; borough engineer.

BRIGHOUSE.—Secondary school and technical institute, Slead House estate (£64,000); West Riding Education Committee.

BROOKWOOD.—Reception hospital at mental institution, for Surrey C.C. (£30,000); W. Townson & Sons, Ltd., Bolton

BURTON-ON-TRENT.—Extensions, Bretby Hall Orthopædic Hospital, block for 32 adults, for Derbyshire C.C.; Martin & Martin and W. H. Ward, architects, 106, Colmore Row, Birmingham (returnable deposit of £2 2s.).

BUSHEY.—Electric lighting installation, Merry Hill school, for Herts. E.C.; county surveyor, Hatfield.

CARLISLE.—Technical school, two central schools, and library and museum extensions, for the T.C.; city surveyor.

CARLUKE.—Extensions, Higher Grade School (£5,780), for Lanarkshire E.C.; director of education.

CHESTER.—Housing scheme (56), for the T.C.; Charles Greenwood, city surveyor, 43, Northgate Street (returnable deposit of £2 2s.).

DURHAM.—Housing scheme (60), Cassop, for the R.D.C.; surveyor.

EASTBOURNE.—Alterations, guardians' infirmary; H. G. Hewitt, architect.

EBBW VALE.—Additional 40 houses, for the U.D.C.; surveyor.

ECCLESFIELD.—Senior school (£11,000) and extensions at High Green school (£3,000); West Riding Education Committee.

FOLESHILL (COVENTRY).—Additional 100 houses, for the R.D.C.; surveyor.

FORRES.—Re-erection of works for Plasmon, Ltd., Farringdon Street, London, E.C. (several thousand pounds).

GRAVESEND.—Housing scheme (30), King's Farm estate, for the T.C.; J. G. Bennett, borough architect, 5, Woodville Terrace (returnable deposit of £2 2s.). Works extensions, Clifton Marine Parade; Imperial Paper Mills, Ltd.

HALIFAX.—Houses (64), Moor End Road, with electric wiring work, for the T.C.; A. C. Tipple, borough engineer, Crossley Street (returnable deposit of £2 2s.). (February 4th.)

HARROGATE.—Secondary school (£65,250); West Riding Education architect.

HINCKLEY.—Re-erection of factories, Factory Road, for John Jackson & Co. and Finn & Dagley.

HORWICH (NEAR BOLTON).—Alterations and additions to Rivington and Blackrod Grammar School (deposit £2); S. Wilkinson, county architect, 16, Ribblesdale Place, Preston.

HORNCHURCH (ESSEX).—Houses (43); Lawes, Cherry and Co., Ltd., builders, 47, Victoria Street, S.W.1.

KINGSTON-ON-THAMES.—Cinema, Bridge Approach, for H. E. Cohen. Rebuilding Row Barge Inn, for Hodgson's Kingston Brewery Co.

KNARESBOROUGH.—Tuberculosis sanatorium, Scriven, near Knaresborough, for 300 patients; West Riding C.C.

LEIGH.—Extension of spinning shed, Victoria Mills, for J. and J. Hayes.

LEITH.—Improved coal shipping facilities at Leith Docks (£120,000, including new hoists); the superintendent.

LONDON (HACKNEY, E.).—Power house, Ash Grove Works; W. J. Bush & Co., Ltd. Factory, Southgate Grove; A. J. King, Ltd.

(STOKE NEWINGTON, N.).—Buildings, for Rock Estates, Ltd., Woodberry Down; S. Hunt.

(BERMONDSEY, S.E.).—Clinic for rheumatism, cancer, &c., Tower Bridge Road; borough engineer.

(LEWISHAM, S.E.).—Extensions, All Saints' Orphanage, Granville Park; A. Coldman & Son. Central clinic, High Street; borough engineer.

LOWESTOFT.—Factory extension, Thurston Road; P. W. Watson & Sons, Ltd.

MOTHERWELL.—Additional 108 houses, for the T.C.; burgh surveyor

MUSSELBURGH.—New grammar school (£56,071); clerk, Midlothian Education Authority, Edinburgh.

NEWTON.—School for Isle of Ely E.C.; R. S. W. Perkins, county surveyor, March (returnable deposit of £3 3s.).

NORTHAMPTON.—Three-storey nurses' home (£25,000), St. Andrew's Hospital; Sidney F. Harris, architect; E. Green & Son, builders.

ONGAR.—Housing scheme (44), for the R.D.C.; surveyor.

OTLEY.—40 houses, Westbourne Estate; U.D.C. surveyor.

PAIGNTON.—Dam across Swincombe Valley (£250,000); G. H. Hill & Sons, engineers. 50 houses, Marldon Hill; Willcocks & Barnes.

REDDITCH.—Factory additions, Edward Street; Abel Morrall, Ltd.

RICKMANSWORTH.—Housing scheme (56), Mill End, for the U.D.C.; A. Freeman, surveyor.

ROMFORD.—Cinema, South Street, Harrington & Evans, architects, 10, High Street.

ROTHWELL.—Re-erection of premises for the Faringdon Shoe Co., Avenue Road (£20,000).

RUNCORN.—Housing scheme (30), Stockton Heath, for the R.D.C.; John L. Beckett, surveyor (returnable deposit of £2 2s.).

SALFORD.—Additional municipal office accommodation; borough engineer.

SETTLE.—Hostel, Girls' High School (£10,000); West Riding Education Committee.

SHIPLEY.—109 U.D.C. houses, Albert Road, Thackley Old Road, Wrose Brow Road; H. Dawson, Council's architect, Somerset House; tenders by January 28th, to H. Barnes, clerk to Council.

STAFFORD.—Housing scheme (47), for the T.C.; W. Plant, borough engineer (returnable deposit of £1 1s.).

STAINES.—Additional 168 lighting points in the Institution, with transformer, cables, &c., and 43 lights for Girls' Home; Board of Guardians.

STEWARTON.—Re-erection of hosiery factory, Bridgend, for John Nairn & Son, Ltd. (£15,000).

STOCKPORT.—Extensions, central premises, for the Co-operative Society, Ltd., with constructional engineering work; S. Lloyd, general secretary (returnable deposit of £5 on each of two contracts).

STOCKTON-ON-TEES.—'Bus garage (£5,810), for the T.C.; P. Duffy, builder, Norton.

SWANSEA.—Estate development, Bryn Newydd, Sketty; T. and G. Spragg. Isolation block; Board of Guardians.

SWINDON.—Maternity hospital, for the T.C.; R. J. Beswick and Son, architects, 10, Victoria Road (returnable deposit of £3 3s.).

THORNE (DONCASTER).—Additional 48 houses for the R.D.C.; surveyor. Houses (36), for W. Wilkinson.

TIVERTON (DEVON).—Re-erection of theatre, for the Conservative Club Committee; secretary.

TORQUAY.—Extensions, Municipal Buildings; Bridgman and Bridgman, architects. Additions, Hotel Metropole, Belgrave Road; F. E. Hall. Additions, Bay Court Hotel, Park Street; F. Williams. Additions, Park Hall Hotel, Park Street; Hotel Co.

WALTON-LE-DALE.—Extension of Lostock Hall Convalescent Hospital; superintendent.

WEYBRIDGE.—Re-erection of Brown House, St. George's Hill, residence of Mr. N. Johnson (£10,000).

WEYMOUTH.—Workshop and garages, Abbotsbury Road; S. Jackson & Sons. Premises in Queen Street (£5,000); Crabb & Co. Re-erection of warehouse, Westham Road, for the Co-operative Society; secretary.

YEOVIL.—Housing scheme (50), for the T.C.; borough surveyor (returnable deposit of £1 11s. 6d.). Houses (48), for the R.D.C.; Petter & Warren, architects.